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Principles of Layout for Self-Service Meat Departments

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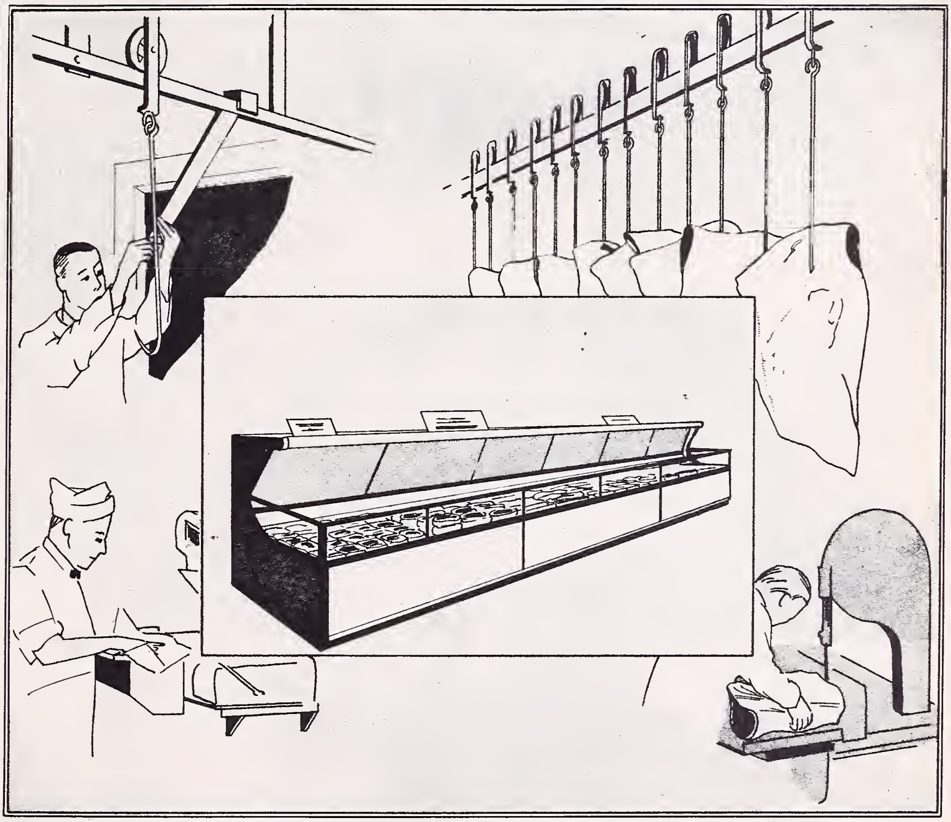

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PREFACE

The study on which this report is based is part of a larger research project designed to improve operating practices of retail food stores. The work is being conducted under the general supervision of R. W. Hoecker, Head, Wholesaling and Retailing Section, Transportation and Facilities Branch, Marketing Research Division, Agricultural Marketing Service. The project is financed from appropriations under the Agricultural Marketing Act of 1946 (RMA, Title II).

The study of the meat operation in retail food stores was conducted in cooperation with Carl's Markets, Inc., of Miami, Fla.; Colonial Stores, Inc., of Atlanta, Ga.; the Kroger Co. of Atlanta, Ga., and Cincinnati, Ohio; and Publix Markets of Lakeland, Fla. The authors express their appreciation to these organizations and to their employees for their assistance in the conduct of the study.

Special credit is due the following: Joseph W. Hatch of Colonial Stores, Inc.; Ivan C. Bowser, Harold Bauerfine, and Julian Weinkle of Carl's Markets, Inc.; Walter Fitzgibbons, R. D. Hardesty, J. B. Hassell, and Jack Wright of the Kroger Co., Cincinnati, Ohio; F. A. Williams, Ray Ecabert, Francis Anthony, D. L. Thornton, and J. A. Bunch, of the Kroger Co., Atlanta, Ga.; and Joe K. Blanton of Publix Markets, Lakeland, Fla.

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SUMMARY

Productivity measured in sales per man-hour increased approximately one-fourth in 7 self-service meat departments when they were remodeled according to the principles of layout set forth in this report and when certain improved methods, materials, and equipment were used. Previous publications have reported on the improved procedures, materials, and equipment for the receiving, blocking, cutting, packaging, and display operations of self-service meat departments. This report sets forth layout principles and the procedures for using them, which, when used in conjunction with improved work methods, materials, and equipment, increased productivity and decreased congestion in self-service meat departments.

Layout principles relating to receiving: (1) A separate door should be used for receiving meat items; (2) meat rails should extend to a point near the door; (3) surface of the back room floor should be flush with the outside area; (4) the meat rail should cause the least interference with other operations of the store; (5) the rail scale should be located so that items on the scale will not interfere with receipt of other rail stock; (6) the platform scale should be level with the floor; and (7) all records, stamps, and other articles used in receiving should be kept near the door in a fixed location.

Layout principles relating to blocking: (1) Rail blocking should be done in a separate area; (2) area should have adequate space to handle entire order; (3) the blocking area should be located between the receiving area and the cooler; and (4) a holding table with necessary tools and meat cans should be provided in the area.

Layout principles for the meat cooler: (1) The cooler floor should be level with the outside floor; (2) door openings should minimize interference with flow of product; (3) the cooler should be provided with multiple rails; (4) direct access to the conveyor carrying meat to the wrapping tables should be provided if cutting or grinding is done in the cooler; (5) the cooler should be large enough to allow the use of carts or dollies; (6) all meat products and equipment should be stored in definite locations; (7) shelves should be provided for delicatessen and luncheon meat items; and (8) frozen meat should be obtained for processing from same general area as other meat products.

Layout principles for the meat cutting area: (1) Each worker should have a separate and complete work place; (2) each work place should permit easy access to the cooler and the meat rail extending from it; (3) the power saw should be located so meat can be passed from the saw to the holding area of the cutting table; (4) each work place should provide for easy disposal of the product to the next operation; and (5) an additional work place in the cutting area should be provided for preparing luncheon meats and cheeses.

Layout principles for the wrapping area: (1) Each worker should have a separate and complete work place; (2) means of moving the product to the wrapper and away from the wrapper with a minimum of human effort should be provided; (3) adequate conveyor area should be provided before and after the wrapping stations for storage of product; (4) a convenient means of

access should be provided to each work station; and (5) extra supplies should be stored close to the area.

Layout principles for the pricing operation: (1) Each worker should have a separate and complete work place; (2) the pricing work place should be located so that travel for displaying is kept at a minimum; (3) the operation should be arranged so the product will pre-position itself on the pricing table; and (4) ample space should be allowed for storage of empty pans or pan dolly racks.

Layout principles that apply to the display area: (1) Pan dolly racks or similar devices should be used for moving product to display; (2) temporary storage of product should be directly below the display of the product when double duty cases are used; (3) sufficient space in the passageway should be provided for opening the doors and inserting or removing pans in the double duty cases; (4) merchandise in a holding cooler should be either clearly visible or its location marked; and (5) doors of the back room should swing in both directions and should coincide with product flow.

Layout principles governing the use of wheel-type conveyors: (1) The minimum pitch that should be used for a conveyor is 1-1/2 inches drop per 10 feet of conveyor; (2) holding space for 3 to 5 pans of product per wrapper should be provided before and after the wrapping operation; (3) the conveyors should be noncorrosive; (4) the height of the cutting, wrapping, and pricing tables should be adjusted to the slope of the conveyor. The best working height for the average operator is 38 inches and all tables should conform to this height as nearly as possible; (5) the top of the conveyor should be about 1/16 inch higher than the tables to which pans are moved and about 1/16 inch lower than the tables from which pans are moved; (6) conveyors should be secured so they will not vibrate; (7) conveyors should be supported independent of the pricing table; (8) there should be no obstacles that will impede the flow of the product; (9) the conveyors should be pitched to the point opposite the tables where the maximum quantity of the product will be wrapped; and (10) the conveyor should bring the product and take it away at table level.

Steps to be taken in developing a complete meat market layout in new stores: (1) Decide on the expected volume; (2) decide what methods of operation will be used; (3) determine the approximate area and location for the meat department; (4) determine from the expected volume of the market the number of workers and the number of work places required; (5) spot the area for each operation; (6) fit the individual work place into the general areas and tie them together; (7) estimate the flexibility and balance of the layout with different volumes of business; (8) locate the walls and other permanent or binding fixtures that enclose the meat area; (9) construct flow diagram and make comparisons with alternate layouts; and (10) make adjustments in layout and construct final flow diagram.

Physical facilities are no better than the methods used with them. One of the most important factors in the successful operation of a self-service meat market is the instruction and training of the market manager and his supervisors in its proper operation. Only when new habit patterns have been created and fully adopted by the personnel can the improved installation be called a success and considered complete.

PRINCIPLES OF LAYOUT FOR SELF-SERVICE MEAT DEPARTMENTS

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Marketing Research Division
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INTRODUCTION

This report covers the third part of an overall study designed to find ways to reduce or hold down the cost of operating self-service meat departments of retail food stores, by improving the layout, work methods, equipment, and materials used in the departments. The first two reports covered an analysis of the receiving, blocking, cutting, packaging, and display operations for the self-service meat department. 1/ This report lists principles that have been developed to aid operators in fitting the various work places and equipment together into a meat market layout that will achieve the most effective use of the work methods, equipment, and materials used. After individual improvements for the receiving, blocking, cutting, packaging, and display operations described in the previous publications were developed and checked separately in several stores, meat market layouts were developed that combined many of these improvements.

In 1953, data on productivity, measured in dollar sales per man-hour, were obtained for one firm in 4 test stores and 4 matched control stores before and after test installations. Sales per man-hour before installation averaged $19.42 in the 4 control stores and $21.31 in the 4 test stores. After installation, sales per man-hour averaged $19.27 for the control stores and $26.43 for the test stores. The net gain in productivity in the test stores over that of the control stores was 25 percent. These savings are due to improved layouts through remodeling plus the adoption of certain improvements in work methods, materials, and equipment. Sales of meat in both the control and test stores averaged about the same after the installation as they did before.

Similar data were obtained for a second firm for 3 test and 3 control stores. For this firm, sales per man-hour averaged $18.53 in the control stores and $17.64 in the test stores. After installation the sales per man-hour for the 3 control stores averaged $19.71 and for the 3 test stores $22.64. The net gain in productivity in the test stores over the control stores was 22 percent. Meat sales in both the control stores and test stores

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1/ Harwell, Edward M., Anderson, Dale L., Shaffer, Paul F., and Knowles, Robert H. Receiving, Blocking, and Cutting Meats in Retail Food Stores. U. S. Dept. Agr. Mktg. Res. Rpt. 41, 55 pp., illus. 1953.

Harwell, Edward M., Anderson, Dale L., Shaffer, Paul F., and Knowles, Robert H. Packaging and Displaying Meats in Self-Service Meat Markets. U. S. Dept. Agr. Mktg. Res. Rpt. 44, 86 pp., illus. 1953.

increased seasonally from the first to the second period but there were no apparent differences in sales between the test and control stores.

The markets in which these increases in productivity were obtained were all remodeled and were subject to many limitations in layout. Not all of the improvements in work methods, materials, and equipment were included in all the layouts.

A number of additional markets have been designed and installed and, although the same extensive records have not been kept for all of them, available data indicate similar results have been obtained where recommended methods have been used with these installations.

The principles of layout used with the improved methods, materials, and equipment to obtain the above increases in productivity were developed by: (1) Use of product and process flow charts for all of the major products handled in the markets; (2) time studies of selected operations before and after changes in layout; (3) use of layout principles developed in other industries; and (4) observations of effect of several layouts on productivity. In evaluating layouts, consideration also was given to the reduction in fatigue through less walking and less manual lifting and carrying.

The principles of good meat market layout can best be explained by discussing them as they apply to each function of the market. As layout is concerned primarily with moving the product through the market between work places and storage areas, the product can be followed through the market step by step and the principles of good layout pointed out for each step.

LAYOUT PRINCIPLES RELATING TO RECEIVING

An efficient layout of the receiving area is needed in order to obtain maximum production in the receiving operation and to eliminate the interference of this operation with other operations of the meat department or with other departments of the store. The following principles should be observed when laying out this area:

1. A separate door should be used for receiving meat items for the store. A separate door for receiving meat means less confusion with other departments, reduces receiving time, and puts the responsibility of guarding the back door in the hands of the meat market manager. The work place of the man who will have to check in the orders should not be too far from this door.

2. Meat rails should extend to a point near the door, allowing enough room on each side of the rail for a 2-man team to hang the meat carcases on the rail. The installation of this rail as near the door as possible or outside near the delivery point if facilities allow, will eliminate much unnecessary walking to and from the rail.

3. The surface of the back room floor should be flush with the outside area so that merchandise may be moved through the door on hand trucks. If this cannot be done then ramps should be built.

4. The meat rail should be located in a manner that causes the least interference with the other operations of the store (fig. 1).

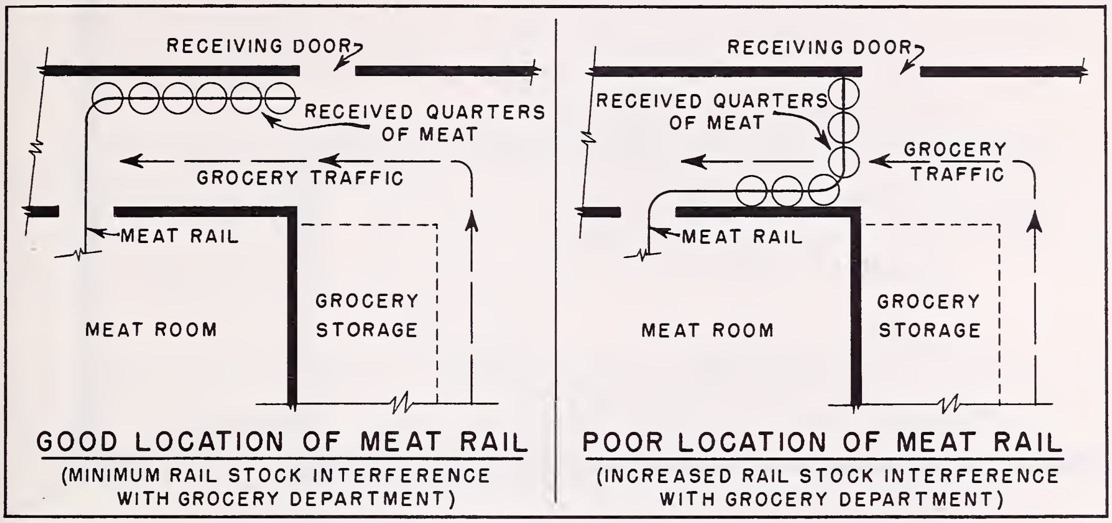
RECEIVING DOOR
RECEIVED QUARTERS OF MEAT
GROCERY TRAFFIC
MEAT RAIL
MEAT ROOM
GROCERY STORAGE
GOOD LOCATION OF MEAT RAIL
(MINIMUM RAIL STOCK INTERFERENCE WITH GROCERY DEPARTMENT)
RECEIVING DOOR
RECEIVED QUARTERS OF MEAT
GROCERY TRAFFIC
MEAT RAIL
MEAT ROOM
GROCERY STORAGE
POOR LOCATION OF MEAT RAIL
(INCREASED RAIL STOCK INTERFERENCE WITH GROCERY DEPARTMENT)

Figure 1.--Placement of meat rail for receiving operation.

5. The rail scale should be located so that items on the scale will not block the door or interfere with receiving carcasses. Rail area, beyond the rail scale, should be large enough to accommodate all of the quarters received except those remaining on the scale.

6. A platform scale level with the floor is advantageous. This should be located to achieve the best product flow without interfering with beef, veal, and lamb carcasses hanging on the rail. If possible, the platform scale should be in the same area as the rail scale and other articles used in weighing. The advantage of locating the platform scale level with the floor is that hand trucks with merchandise can be rolled onto the platform scale and be weighed without individual handling of the merchandise. After being weighed these items can be rolled into the area where they will be stored.

7. All records, stamps, and other articles used in receiving should be kept at fixed places near the door.

LAYOUT PRINCIPLES FOR BLOCKING

If a market handles an appreciable volume of beef, lamb, or veal, the blocking (separation of carcass into wholesale cuts) should be done on a rail. Production is increased, and accidents caused by handling heavy quarters or sides of beef are prevented, when the following principles of good layout are applied to the blocking operation.

1. Rail blocking should be done in a separate area from cutting or any other operation with which it would conflict. All of the tools and equipment needed should fit into this area (fig. 2).

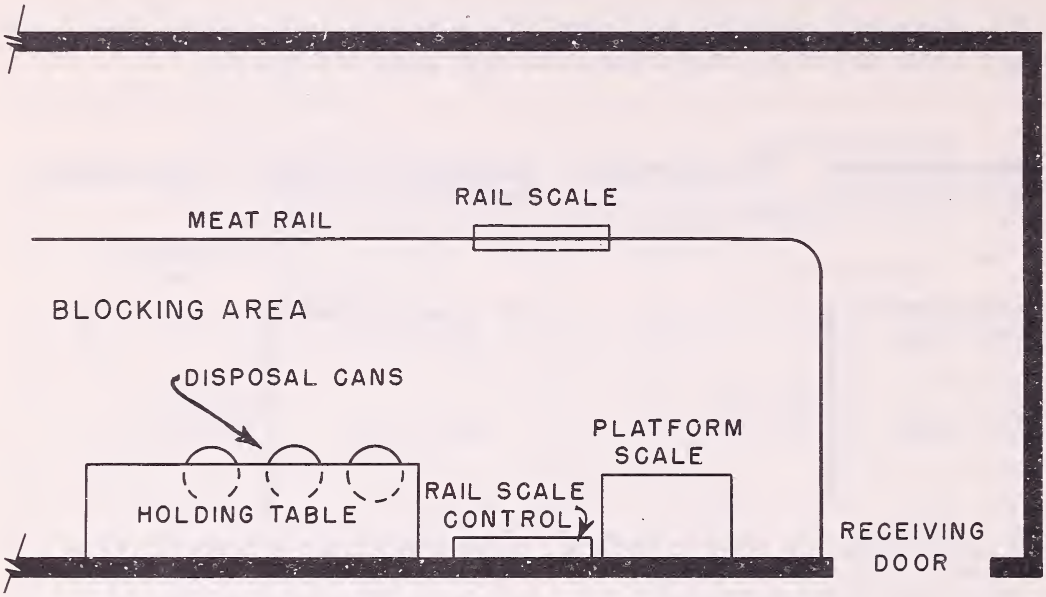

Figure 2.--Combined receiving and blocking layout.

2. The blocking area should have adequate space to block an entire order or shipment of beef at one time up to an approximate maximum of 8 quarters. Approximately 30 inches of rail are needed for blocking each side or quarter.

3. The blocking area should be located between the receiving area and the cooler so the blocking operation can be done as the meat is received, to prevent double handling. When this is done the rail space used to receive, including the rail scale, can be utilized for blocking without interference. [2]

4. A large holding table should be provided in the blocking area and meat cans made available so the operator can dispose of trimmings. Knives and other tools should be provided at this area. The meat cans may be equipped with casters or a small 2-wheel hand truck may be provided so the cans can be moved back into the cooler after blocking.

LAYOUT PRINCIPLES FOR THE MEAT COOLER

The layout of the meat cooler is important enough to deserve special attention. Many markets use the cooler as a place to do several jobs beside its conventional use for holding. Therefore, the cooler should be large enough for doing these jobs and still provide adequate storage. Layout principles that are applicable to the meat cooler are:

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[2] A discussion of improved blocking methods is given in "Receiving, Blocking, and Cutting Meats in Retail Food Stores," pp. 20-21. See footnote 1.

1. The cooler floor should be level with the outside floor so that hand trucks may be rolled into and out of the cooler without lifting or carrying. In addition to increasing production and lessening fatigue, this also reduces accidents. Cooler floors should be left rough to prevent slipping or falling when rail stock or other heavy items are moved about.

2. The cooler door should open in the direction that minimizes interference with product flow. In many markets it was observed that cooler doors were hung so that store personnel had to walk around them in order to obtain merchandise from the cooler. This inefficiency can be overcome by observing the direction of product flow to and from the cooler and swinging the doors according to traffic flow.

3. The cooler should be provided with multiple rails so chucks and rounds can be left on the hooks where they were placed when received. [3] This can be accomplished by hanging the forequarter with the meat hook in the chuck so that in blocking the heavy cuts are left on the hook. Rounds can be stored on one rail, chucks on a second rail, and all of the other cuts of the carcass may be placed on tree hooks or separate hooks and put up on the third rail. By bringing the product in through one door and taking it out another, first-in first-out rotation of merchandise can be simplified (fig. 3). This can also be done in a cooler that has only one door by using a circular rail. Another advantage of multiple rails in the cooler is that they facilitate storage of wholesale cuts in the center of the cooler and make more space available on the cooler wall for storage of other items.

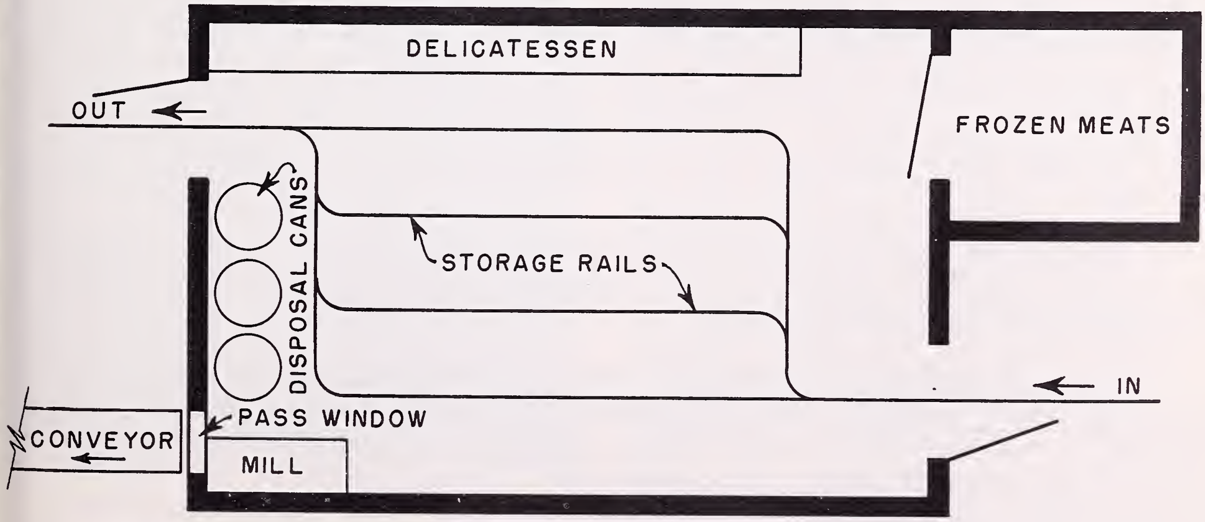

Figure 3.--Meat cooler designed for a first-in first-out supply of meat.

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[3] Ibid., Page 4.

4. Direct access to the conveyor that carries meat to the wrapping tables should be provided when work places such as the ground beef mill are located in the cooler. This can be done with a pass window, as shown in figure 4. When the mill is located in the cooler a separate work place is established and all the tools and supplies, such as peach paper, pans, trays, or boards, that are necessary for the operation should be located there.

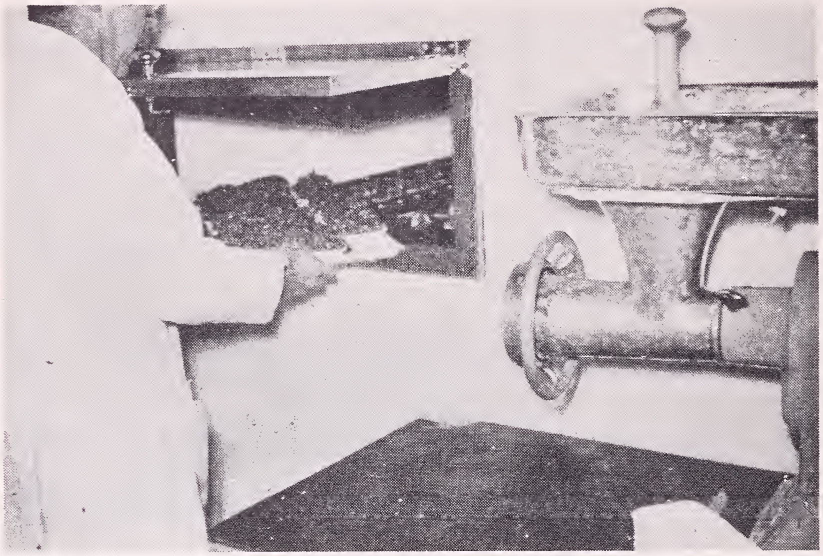

Figure 4.--Mill located in meat cooler with pass window to the conveyor to wrapping stations.

5. The cooler should be large enough to allow the operators to move through it freely with carts or dollies between rail stock and merchandise stored on the walls or wall shelves.

6. All meat and equipment within the cooler should have a definite location to avoid confusion in obtaining products from the cooler. Also, this will aid in making more accurate inventories. Disposal cans containing trimmings to be made into ground beef should be placed near the mill if the mill is in the cooler. If a pass window is used, pan storage racks for storing meat that is cut but not wrapped should be located near this pass window.

7. Shelves should be provided for most delicatessen and luncheon meat items for when these are stored on the floor they may be damaged by moisture or by workers moving other products.

8. Frozen meat should be obtained for processing from the same general area as other meat products and, therefore, the low temperature freezer should be located as conveniently to the cutting operation as possible without interfering with other operations. The frozen meat freezer should be separate from the freezer used by other departments. This prevents conflict between departments on storage space available and prevents blocking of one department's storage area by another department.

LAYOUT PRINCIPLES FOR THE MEAT CUTTING AREA

The principles of good layout applicable to the cutting operation are:

1. Each worker should have a separate and complete work place with materials and equipment he needs accessible to him without leaving this area (fig. 5). He should have sufficient space around him to permit free movements and safe use of tools.

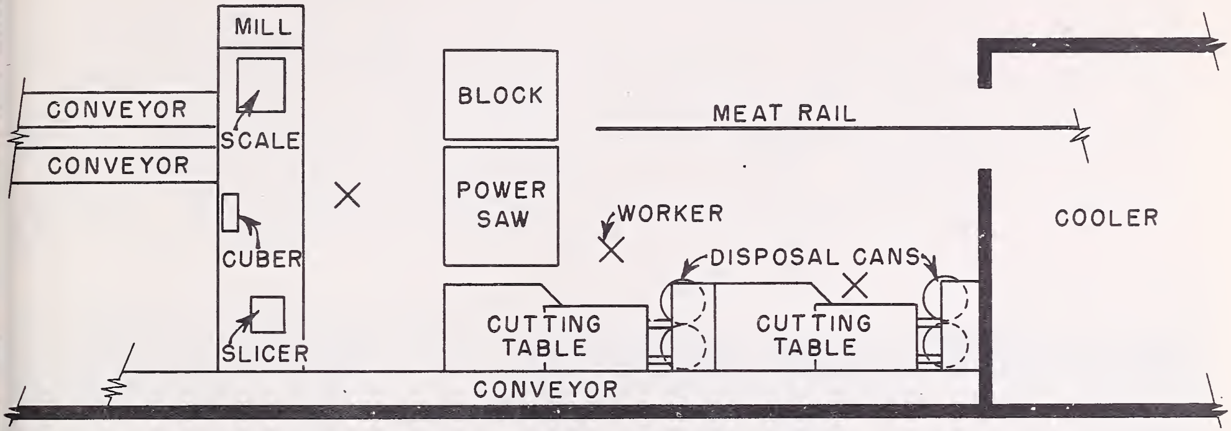

Figure 5.--Layout of work places in a cutting room.

2. Each work place should be located to permit easy access to the cooler and to a meat rail extending from the cooler.

Figure 6.--Improved cutting work place arrangement including power saw with direct pass to conveyors to wrapping station.

3. The power saw should be located so meat can be passed from the saw to the holding area of the table, and so the operators can move quickly from the saw to the table. The best position is with the saw at a right angle to the cutting work place.

4. Each work place should provide for easy disposal of the product to the next operation (fig. 6).

5. An additional work place for preparing luncheon meats and cheeses should be provided in the same general area as the cutting operation. A table for this work should be located as near the cooler door as practicable and should be adjacent to the conveyor carrying the product to the wrapping area. Since slicing with a hand slicer is a

right-to-left operation the conveyor should be to the operator's left for easy disposal of pans. The steak cuber can be placed in this same work place arrangement. In addition, space can be provided for pricing items that do not have to be weighed, and for opening and positioning prewrapped items to be sent to the scales. For that reason access to the conveyor leading to the scale is provided. This table can also be used as an emergency wrapping station.

LAYOUT PRINCIPLES FOR THE WRAPPING AREA

The location of the wrapping operation in a meat department is not as important as the location of some other operations, as by using conveyors there need be little walking from the wrapping area to other areas. The illustration given in figure 7 for a wrapping table illustrates an improved work place arrangement. However, the same principles of layout apply to any type of meat wrapping station. The easy-reach wrapping table supplies everything needed for wrapping, and the wrappers have ample space even when the tables are placed close together. 4/

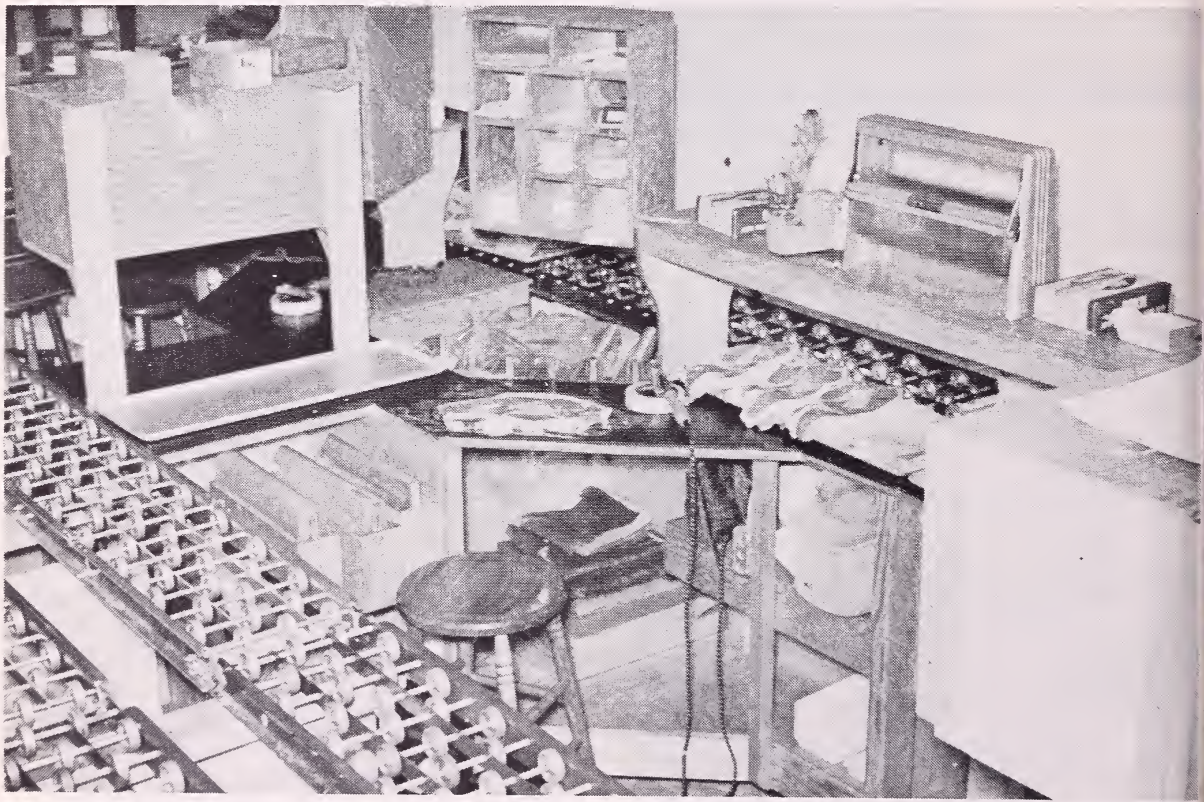

Figure 7.--The improved wrapping work place arrangement with conveyor system for delivering product to and from the work place.

4/ Instructions as to the construction and use of this wrapping station are given in "Packaging and Displaying Meats in Self-Service Meat Markets," See footnote 1.

The principles that apply to the layout of a wrapping area are:

1. Each worker should have a separate work place containing all the tools and supplies needed for wrapping (fig. 7).

2. Means of moving the product to the wrapper and away from the wrapper with a minimum of human effort should be provided. This is important because it favors large pan loads, an essential factor in high market productivity. Conveyors can be located on each side of the wrapping tables so that pans of unwrapped meat can be obtained and pans of wrapped meat can be disposed of by sliding them directly on or off the wrapping tables without the need of turning the pans. This can be accomplished by placing pans crosswise on a double conveyor on one side of the wrapping table and lengthwise on a single conveyor on the other side. As the easy-reach wrapping table makes a 90° turn, one side of the table is parallel to the conveyor placed along its side. The location of meat pans on the conveyor and the location of the conveyor itself are shown in figure 8.

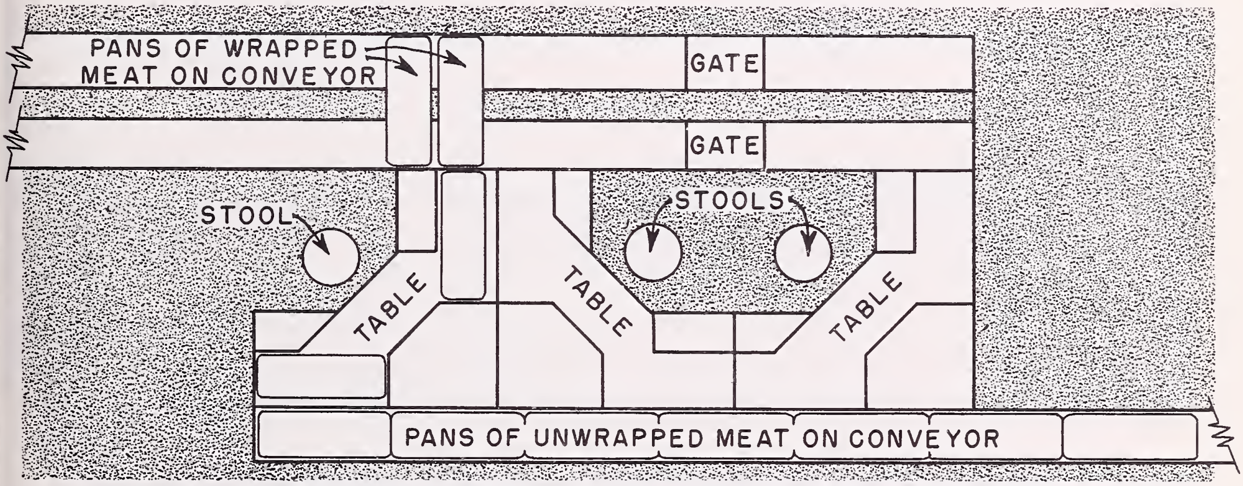
PANS OF WRAPPED MEAT ON CONVEYOR
GATE
GATE
STOOL
STOOLS
TABLE
TABLE
TABLE
PANS OF UNWRAPPED MEAT ON CONVEYOR

Figure 8.--Example of a wrapping station layout.

3. Adequate conveyor area should be provided before and after the wrapping stations for storage of product. Care should be taken to see that the conveyor for pans of wrapped meat has enough space between the scale and the last wrapping station to allow several pans of meat to collect and still leave enough room for the operator of the last wrapping station to slide pans to the conveyor.

4. A means of access to the work stations closed in by conveyors should be provided so that the worker can enter or leave without stooping or bending. Gates in the conveyors prove satisfactory.

5. Extra supplies and materials should be stored close to the wrapping area.

LOCATION OF THE PRICING OPERATION IN THE LAYOUT

The important considerations in locating the pricing operation in a meat department layout are:

1. The pricing operation should have a separate and complete work place with all equipment and supplies within easy reach of the operator.

2. The pricing operation should be located so the amount of travel for the display operation is kept at a minimum. More consideration should be given to placing it near the part of the case that is most frequently used rather than the exact center of the case (fig. 9).

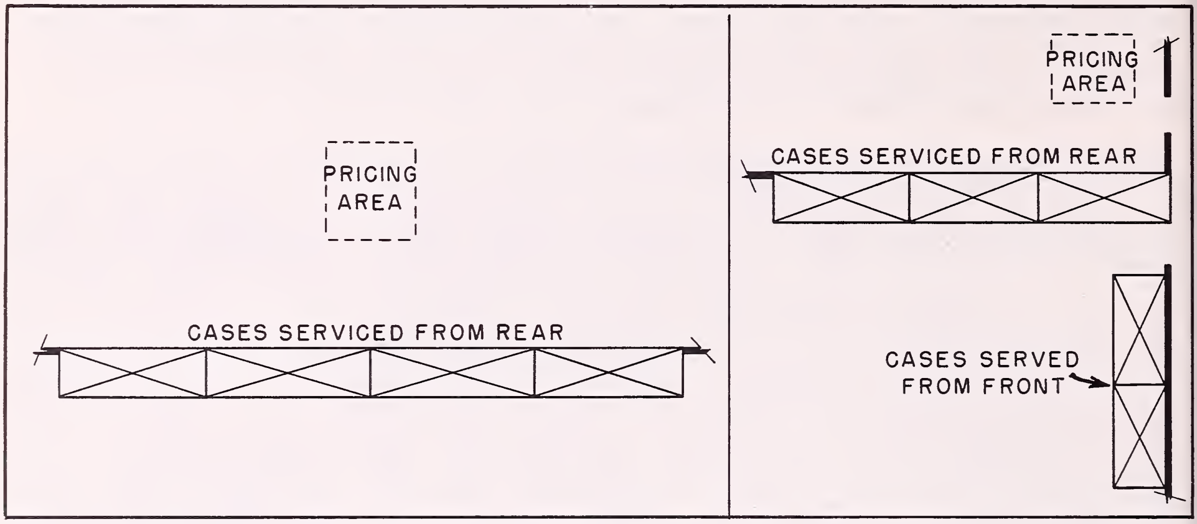

Figure 9.--Location of pricing area for straight line and right angle display layouts.

3. The pricing operation should be arranged so the product to be priced will pre-position itself on the pricing table, and so that the conveyor is sufficiently accessible to permit the operator to make some selection of items in order to help keep like items together. In the pricing operation, shown in figure 10, separate scales and label printing machines are used. The product moves to the scale table on double conveyors and positions itself. The pricing table should be located so that the product flow will be from right-to-left. If a single conveyor is used to carry packages from the wrapping operation to the pricing operation, the pricing operation should be located to the left of the conveyor (fig. 11). This is not as effective as a double conveyor leading into the pricing table because it provides less accumulation area. A pan dolly rack is used to accumulate pans of the merchandise after it has been weighed and priced. The operator may work directly to a pan on top of the pan dolly rack, and transfer the pans to the lower shelves as they are filled.

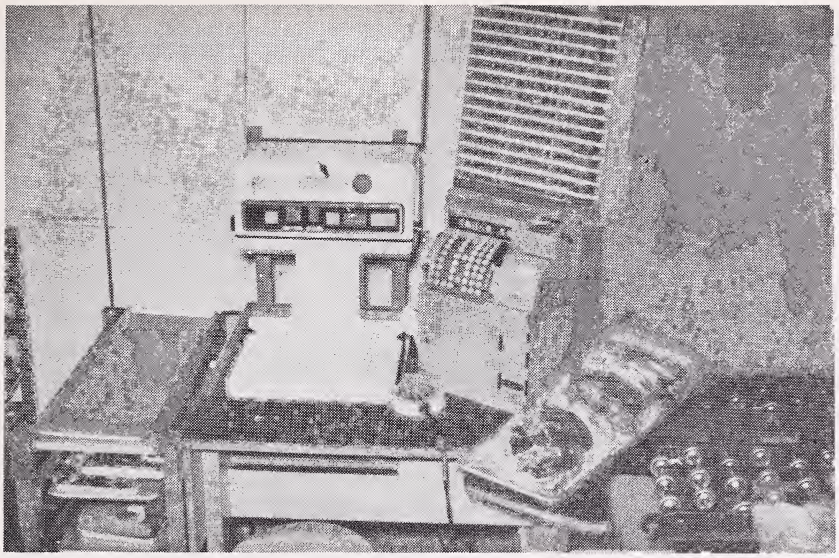

Figure 10.--Improved work place arrangement for the pricing operation.

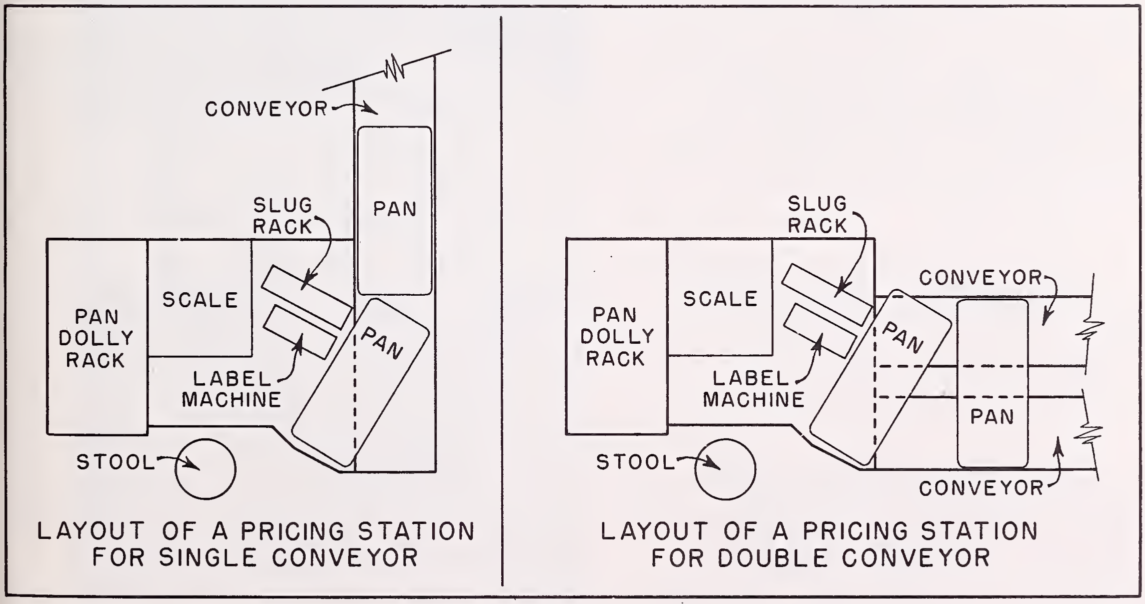

Figure 11.--Two arrangements of a pricing station.

4. Ample space should be allowed for storage of empty pans or pan dolly racks or other equipment. An aisle at least 30 inches wide should be provided between the pan dolly rack and other pieces of equipment so that the pan racks can be moved freely.

Two other means may be used to hold meat after it has been priced. A large table with enough space to hold several pans is satisfactory, especially when a holding cooler is used. Pans can be placed directly in the holding cooler, carried to nearby display cases, or placed in pan dolly racks from the table. Also, a piece of roller conveyor can be used to hold pans after the weighing and pricing operation. A full-length conveyor along the back of the display cases is not satisfactory as the product may move past its display area or move to the wrong end of the case.

LAYOUT PRINCIPLES THAT APPLY TO THE DISPLAY AREA

Research results showed that display cases serviced from the rear required less labor per package for this operation than cases serviced from the front, owing to the shorter walking distances involved. Another advantage of servicing display cases from the rear is that it does not interfere with customer traffic. Double duty cases with storage space for holding the product underneath are preferred to separate holding coolers because they save time in displaying and in taking inventory of the product. One disadvantage, however, of a double duty case is the stooping required to get merchandise into and out of the lower section.

Principles to be considered when laying out the display area are:

1. Pan dolly racks or other similar devices should be used to move the product to the display cases when any appreciable distance is involved (fig. 12).

2. Temporary storage of product should be directly underneath the display area for that particular product when a double duty case serviced from the rear is used.

3. Double duty display cases serviced from the rear should be installed with sufficient space in the passageway to permit opening the bottom doors of the case to store or remove pans of meat freely. If a 30-inch pan is used the minimum width of the passageway should be 36 inches.

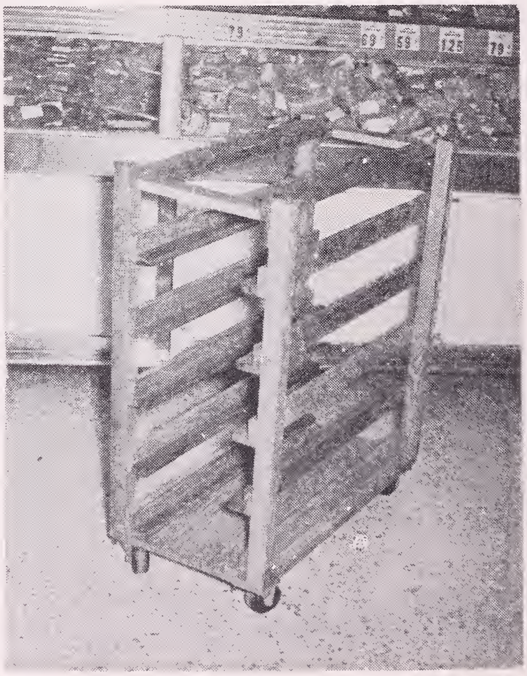

Figure 12.--One type of pan dolly rack used with an improved pricing work place arrangement.

4. The location of the merchandise in the cooler should either be clearly marked or visible through glass doors when a holding cooler is used.

5. The doors of the back room should swing in both directions and be hung to coincide with the traffic flow if it is necessary for employees to leave the back room of the meat department to service the display cases. Small windows are recommended in swinging doors to prevent accidents.

THE USE OF WHEEL-TYPE CONVEYORS IN LAYOUT

Wheel-type conveyors are effective in providing both a holding space and a means of transporting the product within a market. Their effectiveness in connecting the various operations of the self-service meat market depends on the ability of the conveyors to move pans of product from one operation to the next with the correct amount of momentum. Principles that were found to be applicable in the use of the wheel-type conveyors are:

1. The minimum pitch that would move pans properly was found to be $1\frac{1}{2}$ inches drop for every 10 feet of conveyor used, provided the conveyor is in good condition and is properly oiled.

2. Holding space for approximately 3 to 5 pans of product should be provided between the meat cutting and wrapping operation, each wrapping operation, and between the wrapping and the weighing and pricing operations in order to provide for cushions of work and thus minimize waiting times.

3. The conveyors should be noncorrosive.

4. The height of the cutting, wrapping and pricing tables should be adjusted to the slope of the conveyor to eliminate lifting of heavy pan loads. As the wrapping operation can be performed without any walking and requires more time per package than the pricing operation, the height of the wrapping station should be favorable for a sitting or standing position. The best working height for an alternate sitting or standing position for the average operator is 38 inches. 5/ However, it is evident that this height of 38 inches cannot be strictly adhered to if the gravity-type conveyors are used. The height of the middle wrapping table in the wrapping area should be 38 inches, and the other wrapping tables as well as the cutting and pricing tables should be adjusted in height to coincide with the necessary conveyor heights passing along their sides. This can be accomplished at the cutting table by building the pan storage shelves at conveyor height and keeping the working area at the proper working level. An alternate method of working out these heights for the wrapping operation is to build the wrapping tables so the pan storage areas on either side are adjustable. Since only empty pans are moved across the table this gives

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5/ Ralph Barnes, "Principles of Motion Economy." Third edition, 272 pp. John Wiley and Sons, Inc., New York, 1949.

no difficulty. With the use of this system all wrapping tables can be built to the same height and would be interchangeable in different types of installations.

5. The top of the wheel-type conveyor should be approximately 1/16 of an inch higher than the level of the table to which the pans are moved, and the height of the table should be approximately 1/16 of an inch higher than the top of the wheel-type conveyor to which the pans will be moved.

6. Conveyors should be secured so they will not vibrate when they move heavy pan loads. They may be installed with knee braces fastened to fixed equipment or they may be supported from the floor with 2x4 braces. In all instances, the area beneath the conveyor should be accessible for cleaning or for storage. The exclusive use of adjustable stands for conveyors resulted in unstable and unsatisfactory conveyor installations.

7. Conveyors should be supported independently of the pricing table to prevent vibration to the scale. One method of doing this is to end the conveyor an inch or two short of the pricing table with a separate stand and a small space between the conveyor and the table. Sometimes, however, the pans will cross the end of the conveyor and hit the table, jarring the scale. An alternative method of supporting the conveyor is to make the pricing table in two parts with the part holding the scale separate from that holding the label machine.

8. In installing a conveyor care should be taken to see that there are no obstacles to impede the flow of the product. Such things as electrical conduits or equipment supports that are in the way or conveyors that are too close to a wall will cause difficulty.

9. The conveyors should be pitched to that point where the maximum amount of the product will be processed. In moving the product from the cutting table to the wrapping stations, it is sometimes feasible to give the conveyor the usual pitch until it reaches the center of the next to last wrapping station and from there continue the conveyor level to the last wrapping station. This will make the product most available to the primary wrapping stations and will move product to the last station only when the conveyor begins to fill up.

10. The conveyor should bring the product to the table at table level and take it away at table level. A system of one conveyor above another was installed but discarded because operator fatigue was increased by the awkward lifting and removing of pans. All of the merchandise in the top conveyor had to be lifted off, which was impractical when large pan loads were maintained. A comparable situation exists when the second conveyor is installed below the table.

In smaller markets it may not be necessary to use a conveyor system for moving the product between the cutters and wrappers. In any case, however, an area large enough to hold merchandise between the two operations and at the proper height for both the cutter and the wrapper should be provided. A metal-top table on which the pans are placed side by side will suffice in some instances. A comparable holding area should be provided between the wrappers and the weighers. A layout was tried in which the meat cutters moved the product from a cutting table to a metal-top table where it was packaged by the wrapper. No pans were used. For conventional wrapping methods it proved difficult to dovetail the two operations even in small markets.

PROVISIONS FOR BYPRODUCTS AND TOOLS

Consideration should be given throughout the layout for effective handling of such byproducts as bones and fat, and for such waste as empty boxes, papers, and old wrappings from rewrapped meat. A storage space should be provided for such items as empty pans, empty garbage cans, dollies, hand trucks, rail hooks, and other equipment. Failure to provide proper storage space for these items results in their being placed on the conveyor, on work places, or other places where they interfere with the smooth flow of the product throughout the various handling operations.

DEVELOPMENT OF COMPLETE MEAT MARKET LAYOUTS IN NEW STORE DESIGNS

The previous discussions of the principles of layout for a self-service meat market were presented in the order in which the operations are performed. However, in developing a layout certain key operations should be located first and the remaining operations located in relation to these key operations. To illustrate, the procedure followed in laying out a test meat market is given in 10 steps. This market was constructed to do about 90 percent of its volume on a self-service basis and about 10 percent on a service basis. The service items were to consist primarily of fresh fish and poultry.

Step 1. Decide on the expected volume. A maximum and a minimum volume was determined by use of the best information available.

Step 2. Decide what methods of operation will be used. The work place arrangement and the layout should then be built around these operational methods. The recommended layout is based on the following recommended operational methods:

a. Large pan loads and large pans as well as full dollies and and full waste and refuse cans were to be moved. This required working on one product at a time as much as possible, and cleaning up that product before starting another.

b. Adequate storage areas were to be provided for the product between the meat cutters and the wrappers to help level out the work load.

c. In the wrapping operation, outside labeling was to be used in order to provide a better balance between the wrappers and the meat cutters. An outside label operation allowed either the wrappers or the meat cutters to do the boarding or the traying of the product, depending on which one had the heaviest work load.

d. The operation was to be designed so that workers could be shifted from one work place arrangement to another to do different jobs in order to help balance the work load.

Step 3. Decide on the approximate area and location of the meat department. This area should fit effectively into the total store layout. In the test store the meat department was located across the back of the store, the grocery operation was placed along one side of the store, and the produce operation on the other side. The dairy cooler, frozen food freezer, bottle storage, and the rest rooms were located in the right-rear corner of the store behind the produce department and beside the meat department. In this layout the fresh meat cases were located across the front of the meat operation and the self-service luncheon meat and delicatessen display cases were located along the right-hand side of the store (fig. 13).

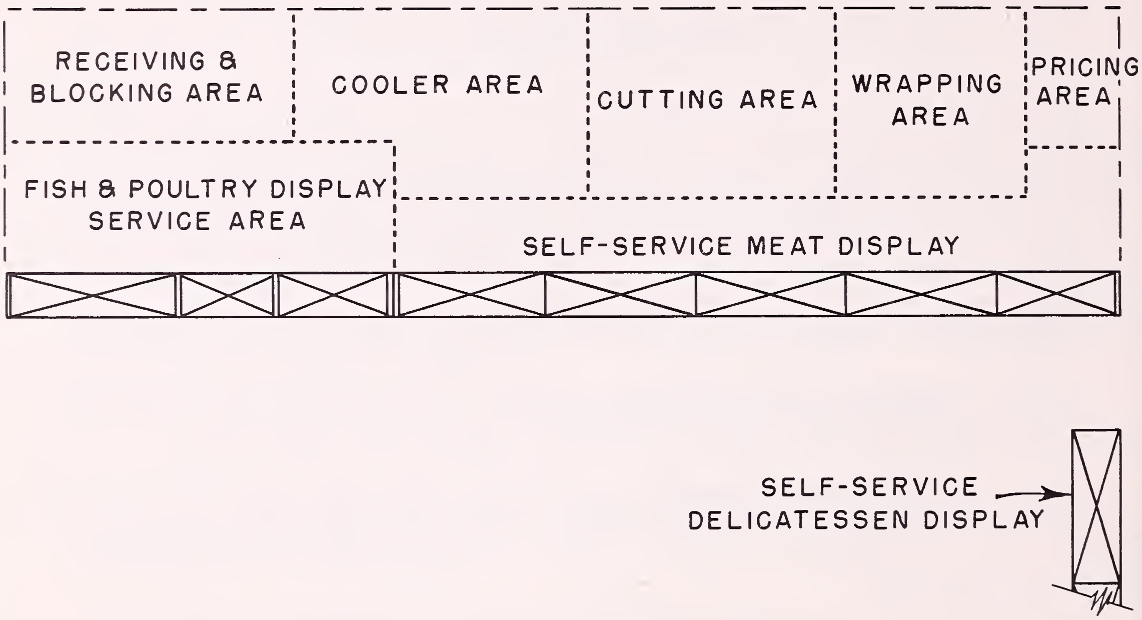

RECEIVING & BLOCKING AREA
COOLER AREA
CUTTING AREA
WRAPPING AREA
PRICING AREA
FISH & POULTRY DISPLAY SERVICE AREA
SELF-SERVICE MEAT DISPLAY
SELF-SERVICE DELICATESSEN DISPLAY

Figure 13.--Location of display cases and work areas in the test meat department.

Step 4. Decide on the number of workers and the number of work places required on the basis of the expected volume of the market. It may be necessary, in a small market, to provide nearly as many work places as in a large market. Even though there are fewer workers in a small market some will have dual jobs performed at different work places. Differences in the methods of preparing the product, in materials used, and worker productivity make it difficult to determine exact standards for each worker; but to maximize production each worker must have a good work place arrangement. However, the average operator cannot afford to provide these work places, tools, and equipment for workers who are below standard. The number of work places should be based on what the average worker can produce. Research results, based on standard figures from the cutting, wrapping, and pricing operations, are of help in determining the number of work places. The number of cutting tables required depends upon the volume of product one meat cutter can handle. Based upon this experience, estimated production per meat cutter doing boning, cutting, and trimming for a 48-hour week is as follows: 4,750 to 6,500 pounds of product; 3,000 to 6,000 retail packages; $2,750 to $4,000 retail value of meat.

The higher productivity represents better methods and equipment. Some operators can work at a faster pace or they have higher degrees of skill and ability than the range indicates. Differences in methods of cutting, as well as the type of meat handled by the store, also have an important effect on production. The above figures include only the product handled by the meat cutter and exclude luncheon meat, cheeses, or items that are packaged or priced only.

Experience has shown the following range to represent what a skilled wrapper can be expected to produce in a 48-hour week when working at an average pace: 5,000 to 8,500 pounds of product; 3,500 to 8,000 retail packages; $3,000 to $5,000 retail value of meat.

The higher ranges of production represent better methods and equipment and use of a hand iron. Slightly higher production can be expected from a seal plate operation, but this requires more film and larger sizes of film, which more than offsets the saving in labor. 6/ Some workers can work at a faster pace or have higher degrees of skill and ability than the average worker represented here. Differences in sizes and types of film, and the average size of packages handled also will affect productivity. The above figures include only the product handled by the wrapper and do not include product which was not wrapped at the market.

Based upon experience with the separate label-printing machine and one type of prepackaging scale, an average scale operator can be expected to handle the following amount of product in a 48-hour work week: 13,000 to 20,000 pounds of product; 12,000 to 13,500 retail packages; $8,000 to $12,000 retail value of meat.

This production estimate is for one girl working alone using an outside label sealed onto the package with a hand iron. Increased production may be obtained from each pricing and weighing station by alternating the pricing operators during lunch and rest periods. In a lower volume market this may not be necessary or desirable but with a larger volume store it may become necessary to prevent a tie-up of two sets of equipment.

6/ See "Packaging and Displaying Meats in Self-Service Meat Markets," pp. 18-22. See footnote 1.

A market that operates its pricing and weighing equipment for 60 or 72 hours a week could expect to increase production per installation to the following:

60-hour work week: 19,000 to 27,000 pounds of product;
16,500 to 19,000 retail packages;
$12,000 to $16,000 retail value of meat.

72-hour work week: 25,000 to 33,000 pounds of product;
20,000 to 22,500 retail packages;
$15,000 to $20,000 retail value of meat.

Allowance should be made for differences in skill and pace of workers. With the improved type of equipment it would pay to locate the best workers at the scale. Experience has shown that operators of scales and label machines usually are better than average workers, and work at the upper ranges of productivity listed here when provided with proper work places and equipment. Productivity of this type of equipment, but not of individual operators, can be increased by the use of two operators on the equipment: One operator places the product on the scale, reads the scale, enters the weight and price in the label machine, obtains the label from the machine, and places it on the package. The second operator seals the label on the package and disposes of the product. While this operation may be useful to market managers during extreme peak periods, it should not be used at other times because of the lower production per man-hour.

When delayed-action labels were used at the scaling operation the use of the seal plate to activate the labels increased production. The operator takes the label from the machine, places it on the seal plate, weighs another package while waiting for the label to activate, and then picks up the label and places it on the package. Care should be taken to see that the label stays on the package when this method is used.

The layout should be designed so that as volume increases additional work places may be provided without seriously affecting the general operational methods. The meat department layout used for illustrative purposes was designed to handle an average volume of $10,000 worth of business a week of which approximately $7,000 would be fresh cut meat. In this market two cutting stations and three wrapping stations were to be provided. One of the wrapping stations was to be used to provide work space for the scale operator or for girls working on delicatessen and special orders when these workers were not busy otherwise. In this market with its anticipated volume one improved pricing work place arrangement was ample.

Step 5. Spot the area for each operation. These areas should be in line and in order. The display cases, although they may be moved later to obtain an optimum fit, serve as a starting point. The pricing operation, with its preferred location, should have first consideration when developing a layout. This location is at the center of the display cases with enough room allocated to the function for it to operate efficiently. Considering both the fresh meat and the delicatessen items, the pricing operation was placed near the end of the main room (see fig. 13).

The store's merchandising department selected the location of the service meat department.

The receiving and blocking operation was located at the opposite end of the meat department from the pricing area in order to get as straight a line of operation as possible. A separate receiving door and a separate blocking area were used to obtain the advantages previously mentioned. The receiving and blocking functions were located at the extreme left of the packing room as these are the first functions performed, and because there was ample room outside the store for trucks to park and unload there.

The meat cooler was located after the general direction of the flow of the product had been determined. As was previously shown, this cooler should be as close to the blocking area as possible. Locating the meat cooler at one end of the blocking area and extending the cooler to the size desired determined the beginning of the cutting area.

The cutting operation is more effective when located as close to the meat cooler as possible. Work places with adequate standing room were located outside the cooler in a position that allowed free passage to the secondary work place containing the slicer and cuber.

The wrapping area was then located in the space between the cutting area and the pricing area.

The use of templates (2 dimensional scale pattern of the areas required) is a recommended method for setting up trial layouts.

Step 6. Fit the individual work places into the general areas and tie them together by a combination of holding areas and transportation such as conveyors (figs. 14 and 15). The designer should bear in mind that some operators may use two work places and see that each work place has ample area for the operator to stand or move about as his job requires.

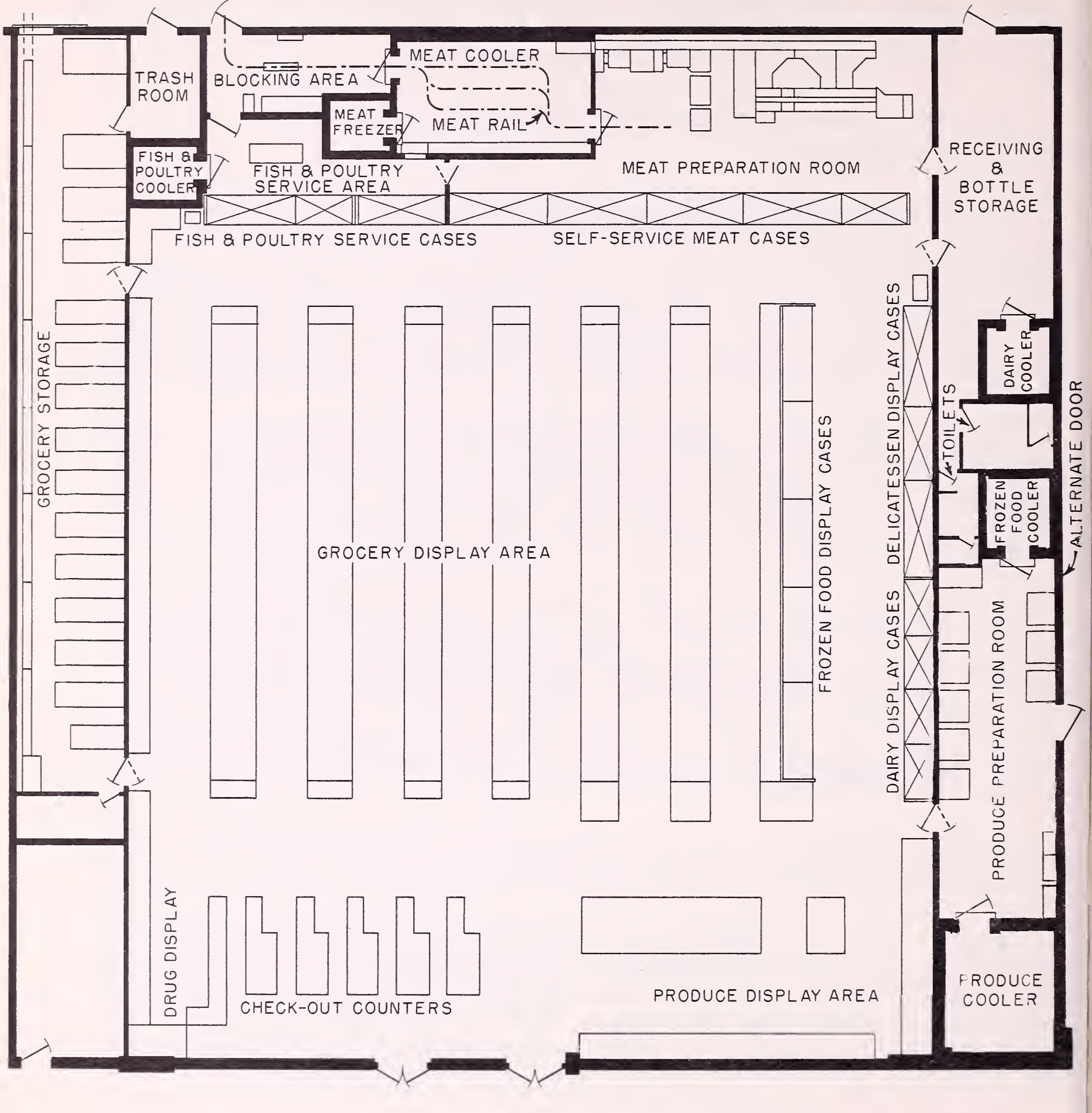


Figure 14.--Complete meat department layout and its relation to the overall store layout.

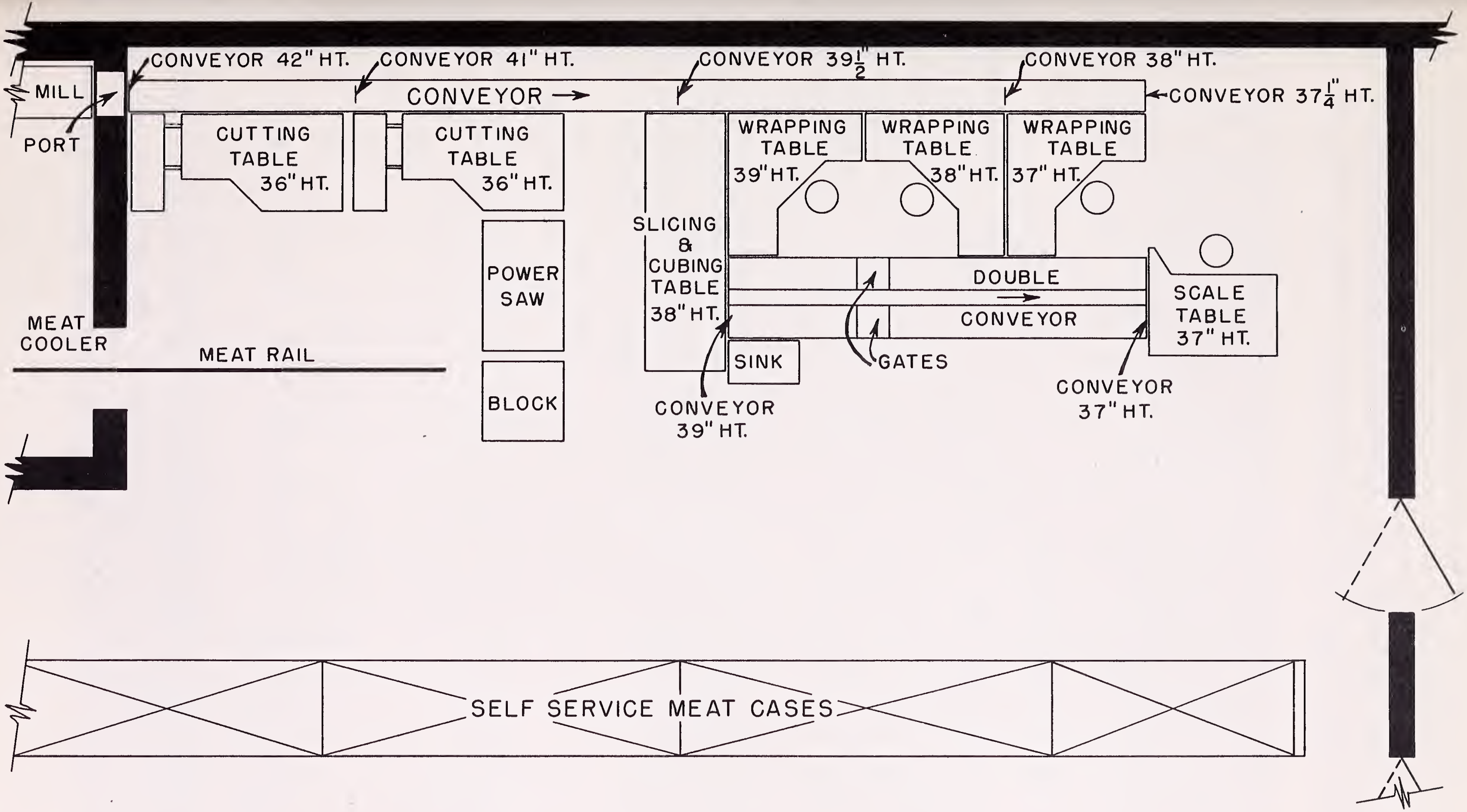


Figure 15.--Enlarged scale drawing of meat preparation room and indicated heights of equipment and conveyors.

The layout for the store provided a receiving rail that comes from the receiving door and curves around to the rail scale. Beyond the scale enough space was provided for rail blocking on one side of the area and a work table for blocking at the opposite wall. The aisle is wide enough to permit the passage of other merchandise while rail stock is hanging on the rail. A platform scale was placed near the receiving door.

The rail leads directly into the cooler where it divides into three separate rails for storing. Shelf storage was provided on one wall and the door to the low temperature meat freezer was on the side of the cooler where the wall was used the least. The mill, with pan storage and a place for cans, was located at the upper right-hand corner of the cooler with a pass window opening to a conveyor in the meat preparation room (fig. 14). The three meat rails joined near the door to that room and one rail leads into it to the right side of the power saw with enough space along this rail to store several quarters of beef before the saw.

The layout drawing for the meat preparation room in figure 14 is shown on an enlarged scale in figure 15. The two cutting work places were located in front of a conveyor along the one wall with the power saw at a right angle to the second cutter's work place (fig. 15); thus, ample room between the work place and the rail is provided for each meat cutter. An additional work place with a slicer, cuber, and a small mill was placed on a large table behind the power saw with the slicer near the conveyor. The second or wrapped-package conveyor leads off this table and any meat received wrapped and unpriced can be placed on this conveyor from the table. If needed, this table can be used as an extra wrapping table. On the other end of this table the cuber and small mill were placed for handling special orders. The job of the girl working at this table is to handle cheese, luncheon meat, delicatessen items, and all special orders. A sink is located near the end of the table for the convenience of washing pans and other equipment.

The conveyor along the wall leads to the three wrapping tables. Two of these tables were set for a right-to-left flow of product; the middle one was set left-to-right. The advantage of this arrangement is that only one gate needs to be provided in the conveyor for passage into and out of the wrapping stations. One of these wrapping tables is intended to be used only in emergencies. A double conveyor was installed for wrapped meats because it provides more holding area and pre-positions the pans at the scale. Areas were provided around the scale operation for the storage of empty dollies used to move the product to the display cases. After the location of the conveyor was decided on, the height of the conveyors at the wrapping tables and pricing table was adjusted to the 38-inch height of the central wrapping table (fig. 15).

Step 7. Estimate the flexibility and the balance of the layout with different volumes of business. If the test store layout is operated with a low volume, one meat cutter would be expected to do the receiving and blocking, run the mill in the cooler, and also do some cutting at the work place by the cooler door. The worker at the slicing table would be expected to do some wrapping at one of the wrapping tables, and the scale operator would be expected to do some wrapping at the table near the scale. In this layout, the movement of one meat cutter to the blocking and receiving area and back is not the ideal arrangement but would be required because of the space required by this design. (Better designs from this one standpoint are shown in figure 17.)

At high volumes of business the dual use of work places becomes less important. In the test store layout, these workers could be used: 2 meat cutters; 2 service counter workers; 1 boxman to handle receiving, blocking, grinding, and some preparatory cutting; 1 manager, 1 slicing table operator; 3 wrappers, 1 weigher; and 1 person to do display work. Additional cutting and wrapping tables and a scale table could be added between the conveyor and the display cases.

Step 8. Plan the walls and other permanent or binding fixtures that enclose the meat area. General consideration for the shape of the meat department was given as the layout was developed but only at this point can the exact space needed for the operation be finally determined (see fig. 14). It may be necessary for the designer to go back over the layout in order to conserve space, get a better fit on the building site, or obtain a better tie-in of the meat department with the other departments of the store. Effectiveness of the over-all store operations often requires some compromise with the principles of good designs for the meat department, but this should be avoided if possible.

Step 9. Construct flow diagram and make comparisons with alternate layouts. Whether a market is new or remodeled, one good check on its effectiveness is to develop process flow charts for each item and compare these charts with those for the original or other layouts. Each product should be followed step by step through the market. Whether the process flow charts are written out in the form shown in the Appendix, or simply thought through by the designer, they should be triple checked with someone thoroughly familiar with the operation of the market for that firm.

Step 10. Make adjustments in layout and construct final flow diagram. Usually after the first flow diagrams are made, desirable adjustments in the layout become apparent. After the designer is satisfied that he has the best layout for the available facilities, a final flow diagram should be made.

ALTERNATE LAYOUT SITUATIONS

Management should not attempt to copy the layouts given in this report unless the methods of operation are completely the same. Most management may find it necessary, because of certain space limitations, to design entirely different layouts. The principles of good layout, however, should always apply. For instance, as shown in figure 16, the same principles of layout would apply to a wrapping operation using inside labels. The product can be weighed and placed on the conveyor moving to the wrapping operation; after it is wrapped it can be accumulated on pans on the conveyor. These accumulated

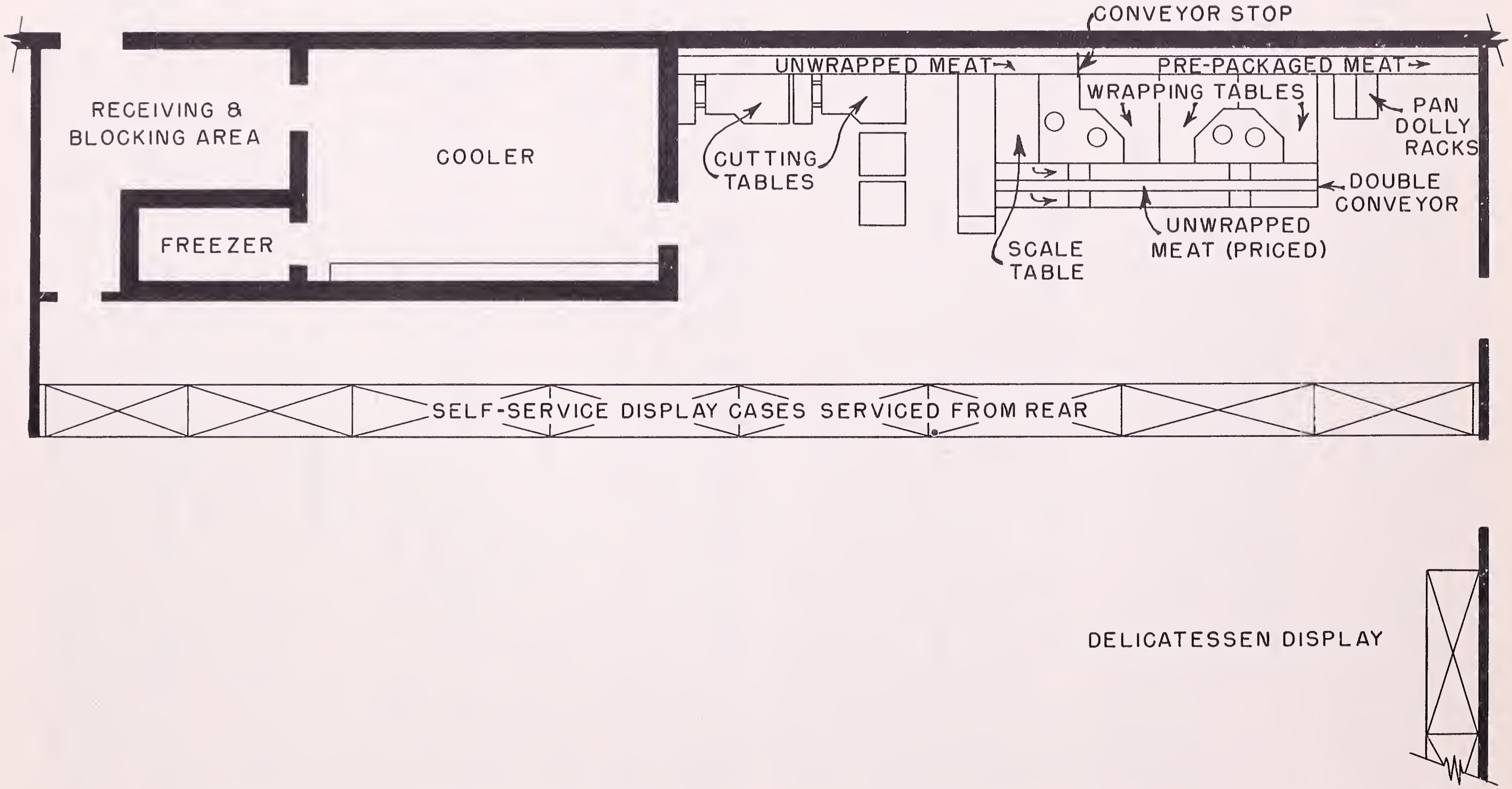


Figure 16.--Self-service layout using inside meat label.

pans of product can then be placed on the pan dolly rack and moved to the display cases. In this instance the conveyor along the wall has a stop at the scale. This layout is for a 100 percent self-service market, and the scale is located nearer the center of the cases across the rear of the store than it was in the first test store layout. This inside labeling operation, however, appears to have the following disadvantages: (a) Although some time is saved by eliminating the need of attaching the meat label to the package, the inside labeling operation requires one or more additional handlings of the pans between the time the meat leaves the cutting operation until it is placed on the pan dolly rack; (b) an additional storage area is required which makes it more difficult to get a smooth flow of product in balancing the workload between the different operations; and (c) as the product must be boarded or trayed before it arrives at the wrapping operation, this must be done by either the meat cutters or the scale girl or else as a separate operation.

In the first two layouts discussed the designs were for a market with space available on three sides for back rooms, and where a shallow back room was desired at the rear of the store. Although such layouts give increased handling efficiency in all departments they cannot be used in some stores. Frequently stores are long and narrow and all of the back room space must be at the rear. In such a store a layout which is approximately square may be best. However, if the back room area is 50 feet or more in depth the same basic arrangement as in figure 14 may be used by placing the blocking area beside the coolers.

Figure 17 shows a layout for a 100 percent self-service meat department with a deep back room area extending 36 to 38 feet from the back of the display cases to the back wall. This layout has an advantage over the previous layouts in that the blocking area is more accessible to the cutting area. On the other hand a disadvantage is that the first cutting position is not at right angles to the power saw. In order to provide for this feature the packaging area would have to be shifted to the left, giving an off-set wall.

Examples just shown are for markets doing from $8,000 to $12,000 of meat business per week. A layout for a large volume store is shown in figure 18. The same principles of good layout are followed in this design as in the other markets. Figure 19 shows the application of these principles in a medium-sized market.

EXAMPLES OF IMPROVED LAYOUT AND EQUIPMENT INSTALLATIONS IN REMODELED MARKETS

The reconversion of an old market to a new layout usually presents more problems than designing a new market layout since there is less flexibility in arranging equipment and walls. The installation of improved layouts in existing markets will be illustrated by examples of conversions in two different firms. Such features as existing walls, coolers, and types and location of display cases and meat rails must be considered when converting an existing market into an improved layout and often compromises must be

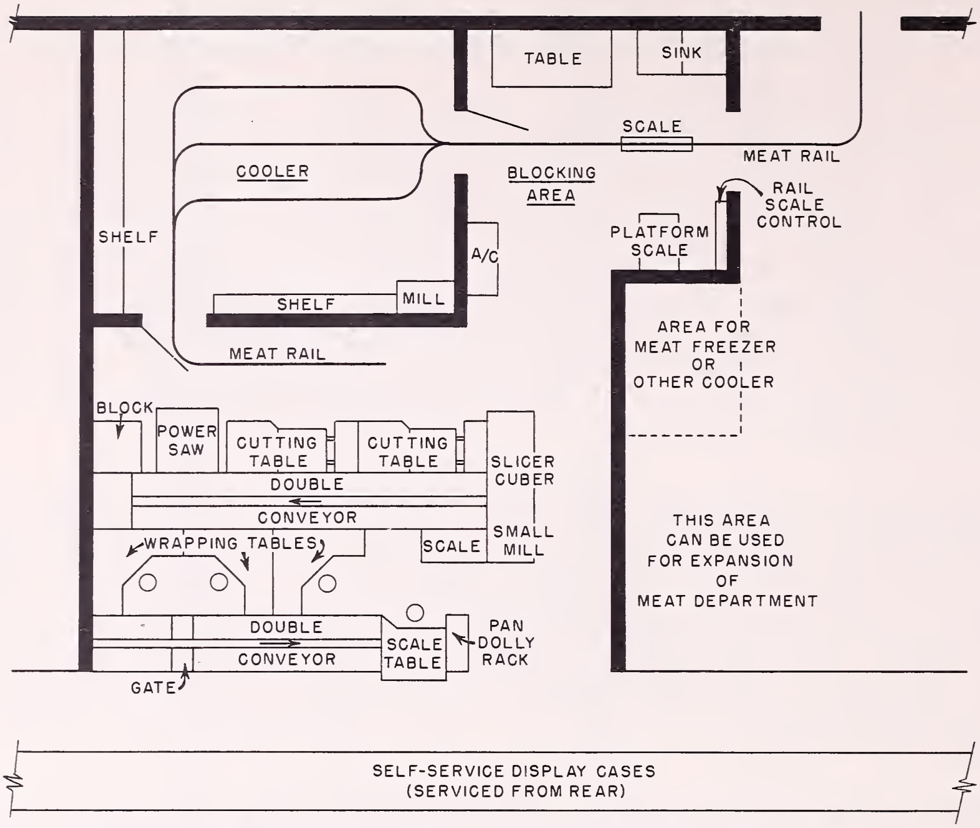


Figure 17.--A meat layout for a store with a deep back room area.

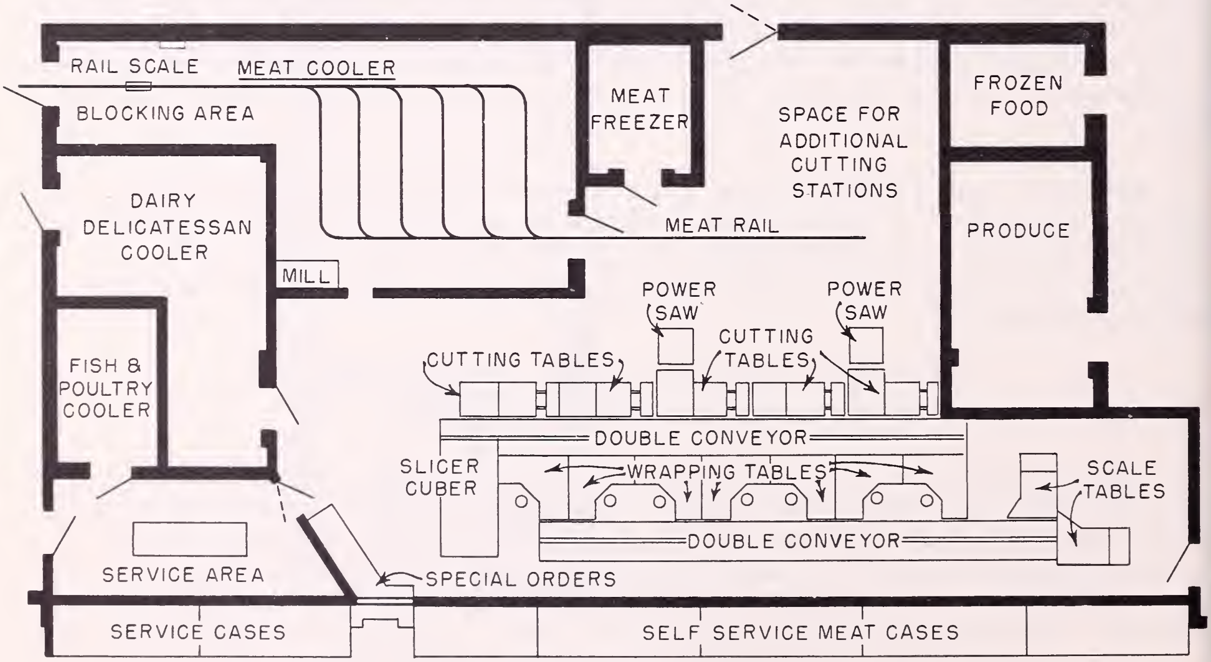


Figure 18.--Layout for a large-volume market with service fish and poultry.

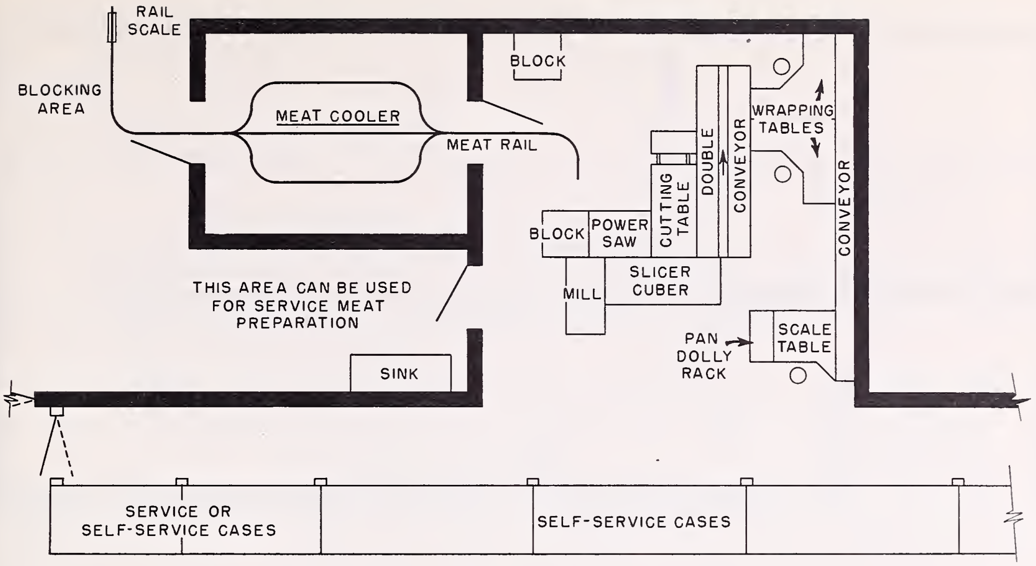


Figure 19.--Layout for a medium-sized market showing alternate service or self-service fish and poultry.

made with what the designer believes to be the ideal layout. The benefits to be derived from an improved layout in comparison with the cost of the change is the determining factor.

An analysis of a typical unimproved meat department operation shows some of the benefits to be obtained from an improved layout. In Firm A's market there was a partition between the cutting room and the packaging operation (fig. 20 A). This partition had a pass window that was seldom used because the conveyor adjacent to it was generally filled with pans of meat (fig. 20 B). Cutting positions were located on both sides of the room (fig. 20 C), making it necessary in most cases for the meat cutters to walk to the end of the conveyor in order to dispose of pans of product (fig. 20 D). A single conveyor was used for both wrapped and unwrapped meat (fig. 20 E). Often unwrapped meat would move down the conveyor to the pricing operation and had to be carried back to the wrapping area. Frequently when the conveyor was filled it was necessary to carry by hand the wrapped merchandise to the scale and pricing operation (fig. 20 G).

There was no accumulation area for wrapped and priced packages, which made it necessary for the weigher to take each individual pan of product to the holding cooler or to the display cases. The doors leading to the display cases opened into the meat processing area, which was in the opposite direction of the product flow (fig. 20 H). The small mill and cubing machine were located in the cutting area (fig. 20 I) making it necessary to walk into the cutting area each time a special order from a customer was processed.

In the improved layout for this market, the only structural change to the store was the removal of the partition between the cutting and packaging operations (fig. 21). The principles of good layout, discussed previously, were applied, and most of the deficiencies of the typical operation were overcome.

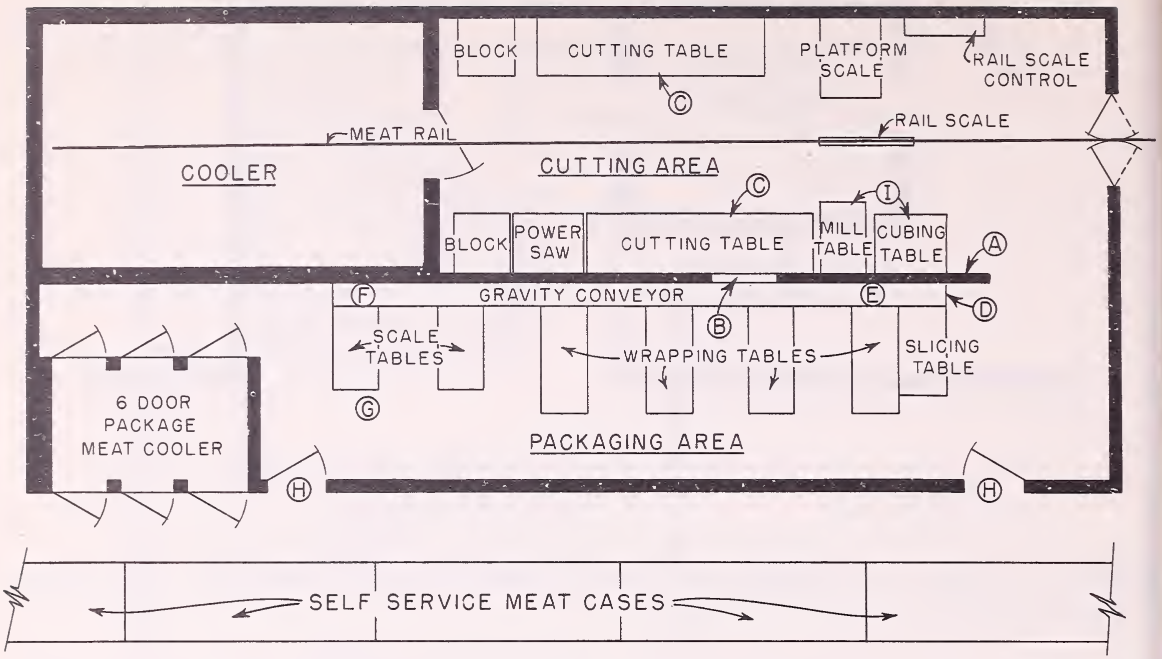


Figure 20.--Typical unimproved meat department layout in Firm A.

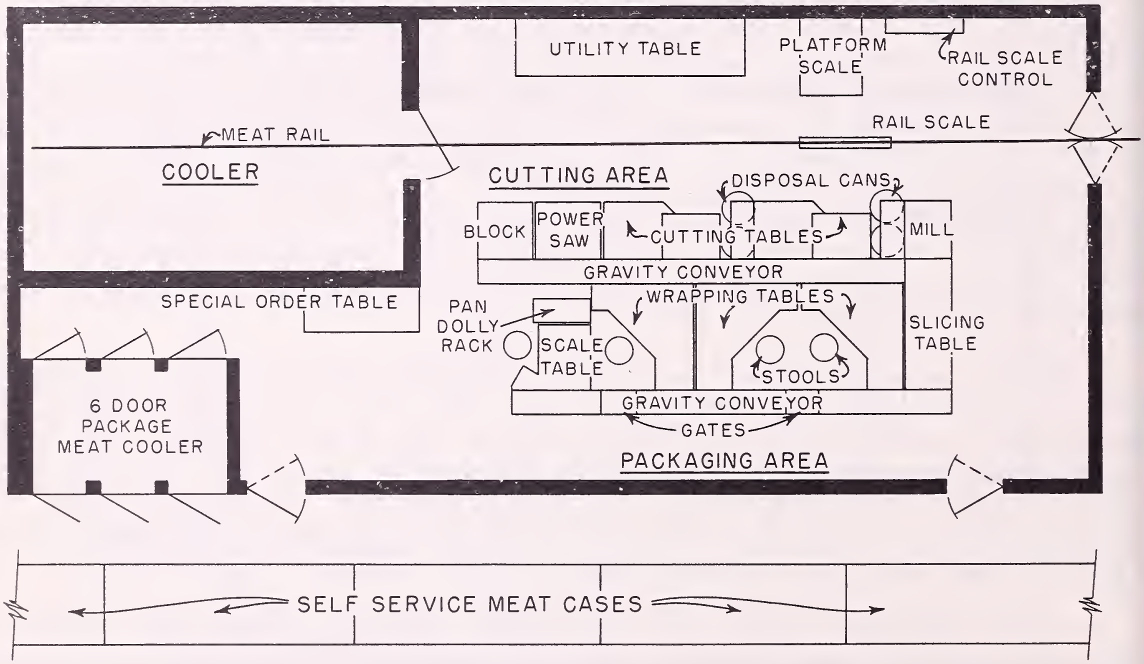


Figure 21.--Improved meat department layout in Firm A.

The pricing operation was located between the holding cooler and the display cases. This was done because of the permanent location of the holding cooler and because studies of this market indicated that approximately 25 percent of the packages ready for display were placed in the holding cooler before they were placed in the display cases. The location of the power saw in this layout is an illustration of the kind of compromise that must be made sometimes. By minimizing many of the disadvantages of the original layout with improved methods, materials, equipment, and layout, it was possible to effect a savings of two workers in this test store. Employees were not required to work any harder to save this time, and many voiced the opinion that their work was much easier.

Another example of a typical unimproved meat department is Firm B, which was under different management in a different section of the country (fig. 22). In this market the location of the cutting operation and power saw presented a particular problem. The power saw (fig. 22 A) was at a considerable distance from the cooler alongside a small holding table (fig. 22 B). Meat cut on the power saw had to be carried to the cutting tables (fig. 22 C) where scrapping and an additional trim were performed. The product then had to be carried to the boarding and traying operation where this function was performed separately (fig. 22 D).

After the product was boarded or trayed (an extra handling) it was placed on the end of a single conveyor (fig. 22 E). Tables were placed at right angles to the conveyor. Wrapped and unwrapped meat on the same conveyor caused the same difficulties encountered by Firm A. Meat to be ground on special order from the customer had to be carried inside the cooler and ground on a large mill (fig. 22 F), as no small mill was available. This created a traffic problem as personnel went in and out of the cooler. There was no accumulation area for storage of the price-marked items at the pricing operation and each pan was carried to the display operation individually (fig. 22 G).

Another version of this type of layout was the "bench" type. No conveyor was utilized and the product was manually carried through all operations of the meat department. The location of the power saw, cutting tables, and boarding or traying operation, in this layout, were the same as in figure 22. The wrapping and pricing operations were located in the same area along the cooler wall. Wrappers worked along the bench but did not work in a definite area. Pans of product had to be carried to the wrapping operators and held on the benches. After wrapping, the pans of product were stored on the bench in the same manner for the pricing operation. All pans progressed through the packaging operation manually. One of the biggest disadvantages of this type of packaging operation is the lack of a fixed work place arrangement with all materials, tools, and equipment close at hand.

An improved layout for Firm B (fig. 23) was installed in both of these types of markets without structural changes to the store. Limited space made it necessary to locate one of the cutting tables a short distance away from the conveyor. Adoption of improved methods, equipment, materials, and layout effected a saving of three workers with the same volume of sales.

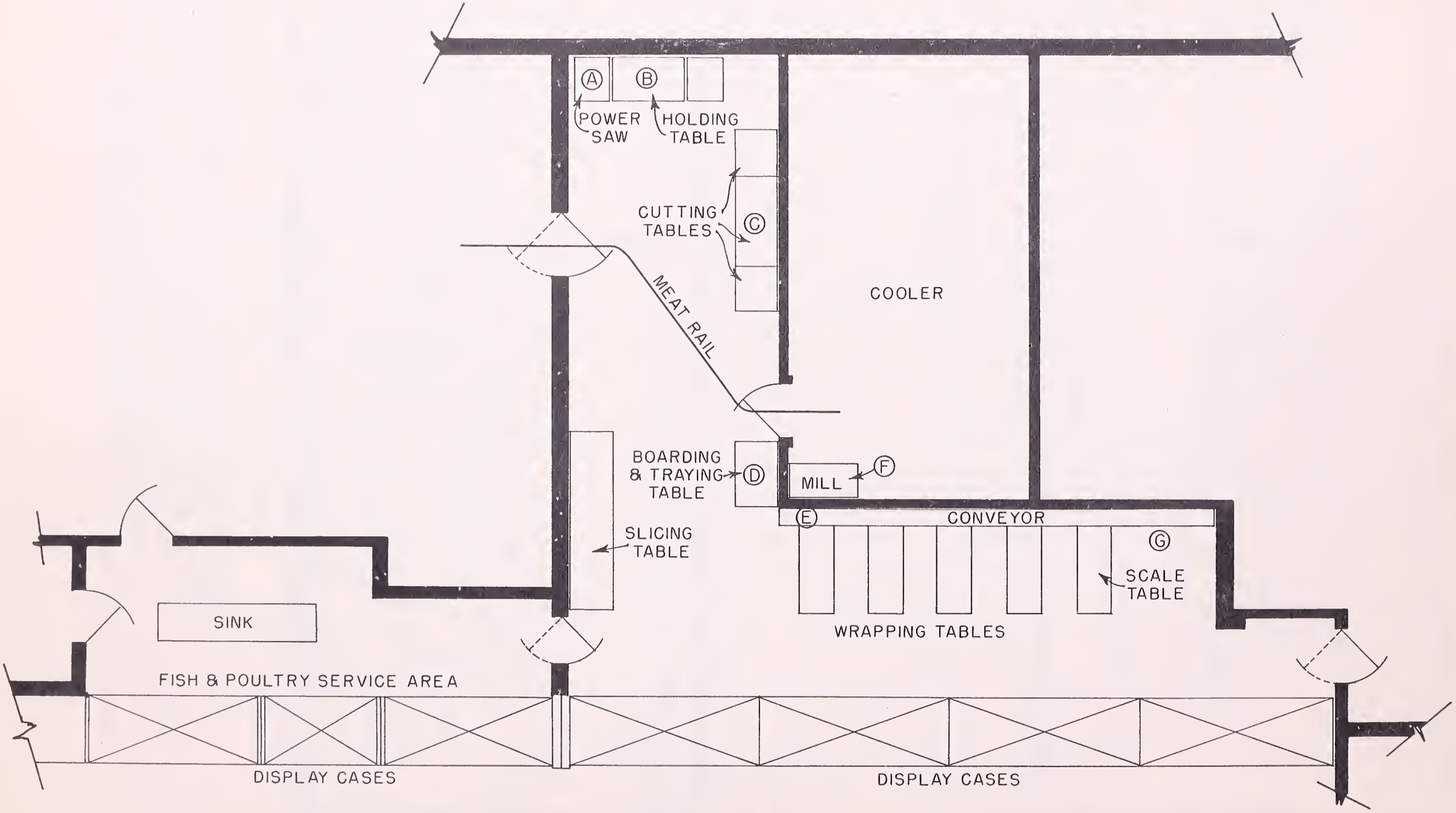


Figure 22.--Typical unimproved meat department layout in Firm B.

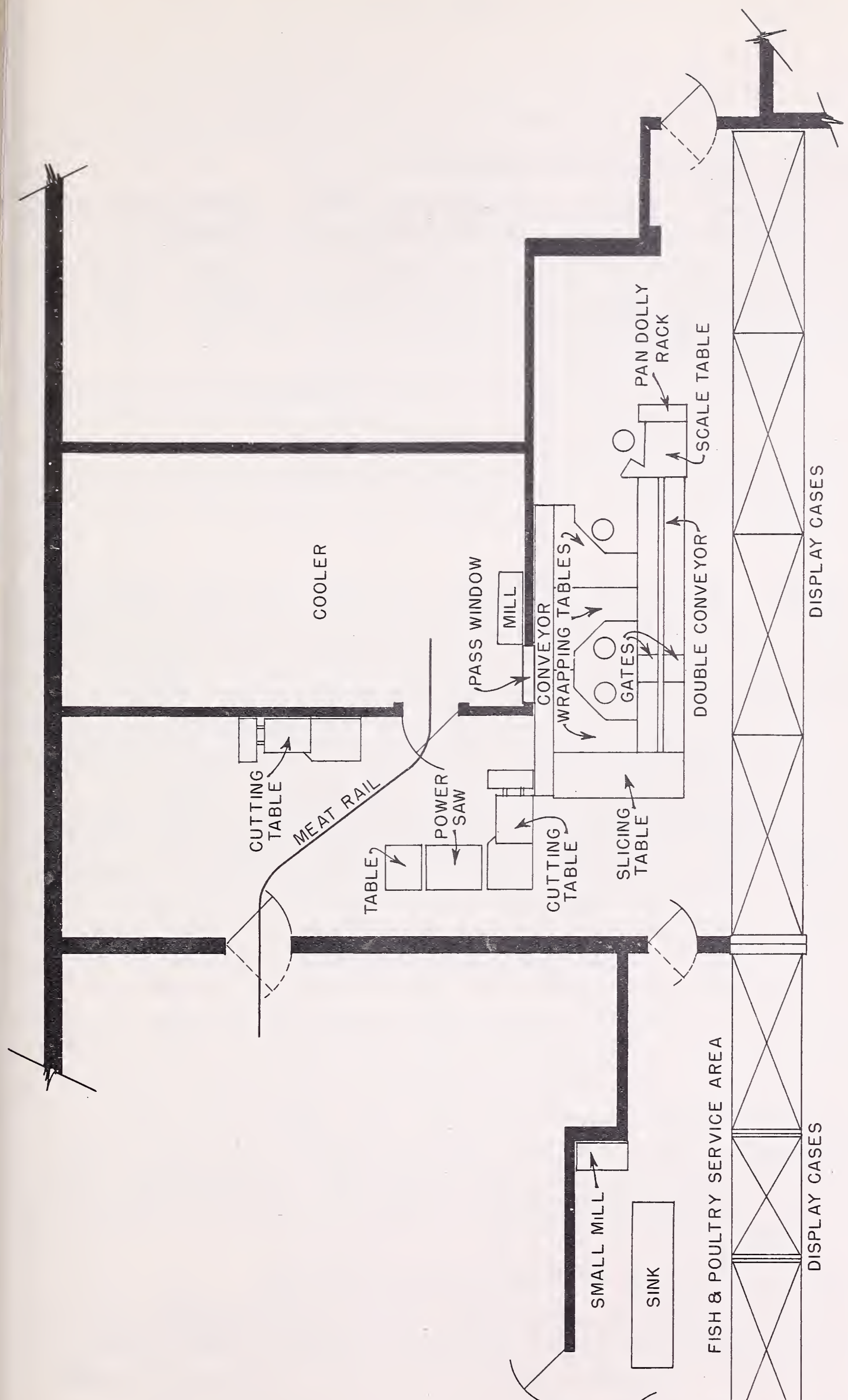


Figure 23.--Improved meat market layout in Firm B.

INSTRUCTING AND TRAINING EMPLOYEES

The substantially increased productivity of labor and the less fatiguing work conditions achieved in test markets were the cumulative effect of many small savings. Each change adopted in a market has some effect on other operations in the market, and to adopt one recommended practice without the others should not be done without careful consideration.

Although use of improved equipment, materials, methods, work places, and layout is a practical solution to many problems for the self-service meat store, it is not a panacea. Physical facilities are no better than the methods used with them. One of the most important factors in the successful operation of a self-service meat market layout is the proper instruction and training of the market manager and his supervisors.

Important in the operation of any market is the scheduling of the workers' hours and the scheduling of the product flow. By planning the work far enough in advance the product can be available when needed and the manager can prevent many interruptions to the production line. These interruptions, along with those caused by special order requests, are some of the big factors in disrupting a smooth flow of production.

A well-trained market manager will keep the conveyors clear of trash and empty pans and the aisles and the wallways clear of trash and stray equipment. He will see that he has a sufficient supply of materials on hand at all times and that they are where they belong. He will help to train the workers in using improved methods, and will insist that they be used at all times.

It should be the duty of supervision not only to understand the best use of methods, equipment, materials, and layout, but also to see that the manager and the market personnel continue to use equipment and methods correctly. However, all of these improvements should be made with caution. Most people tend to resist any change that upsets old routines. Even though all of the ideas presented here are based on common sense, a completely new installation often bewilders the most experienced employee. It is essential and also good policy to explain to the personnel who will use the equipment and methods why the equipment was designed in such a manner or why such a method is to be used. The most successful method of making an installation or change is to make the operating personnel a part of the program, paying particular attention to their comments and answering any questions they may ask about the change.

As most of the operations in an improved layout may have been changed somewhat, supervisors should take time to make sure the changes are well understood by all concerned. Only when the new operational procedures are fully adopted and new habit patterns have been formed by the personnel, and these are understood and enforced by management, can the improved installation be called a success and considered complete.

HOW A LAYOUT CAN BE MEASURED AND EVALUATED

An effective method to follow in developing layout improvements is a step-list analysis of the flow of product through the market. Most people designing a market do follow a somewhat similar process by thinking through the movement of product. Many errors can be prevented and a much more effective layout developed by using a step list or flow chart showing each movement of the product from the time it enters the market until it is sold.

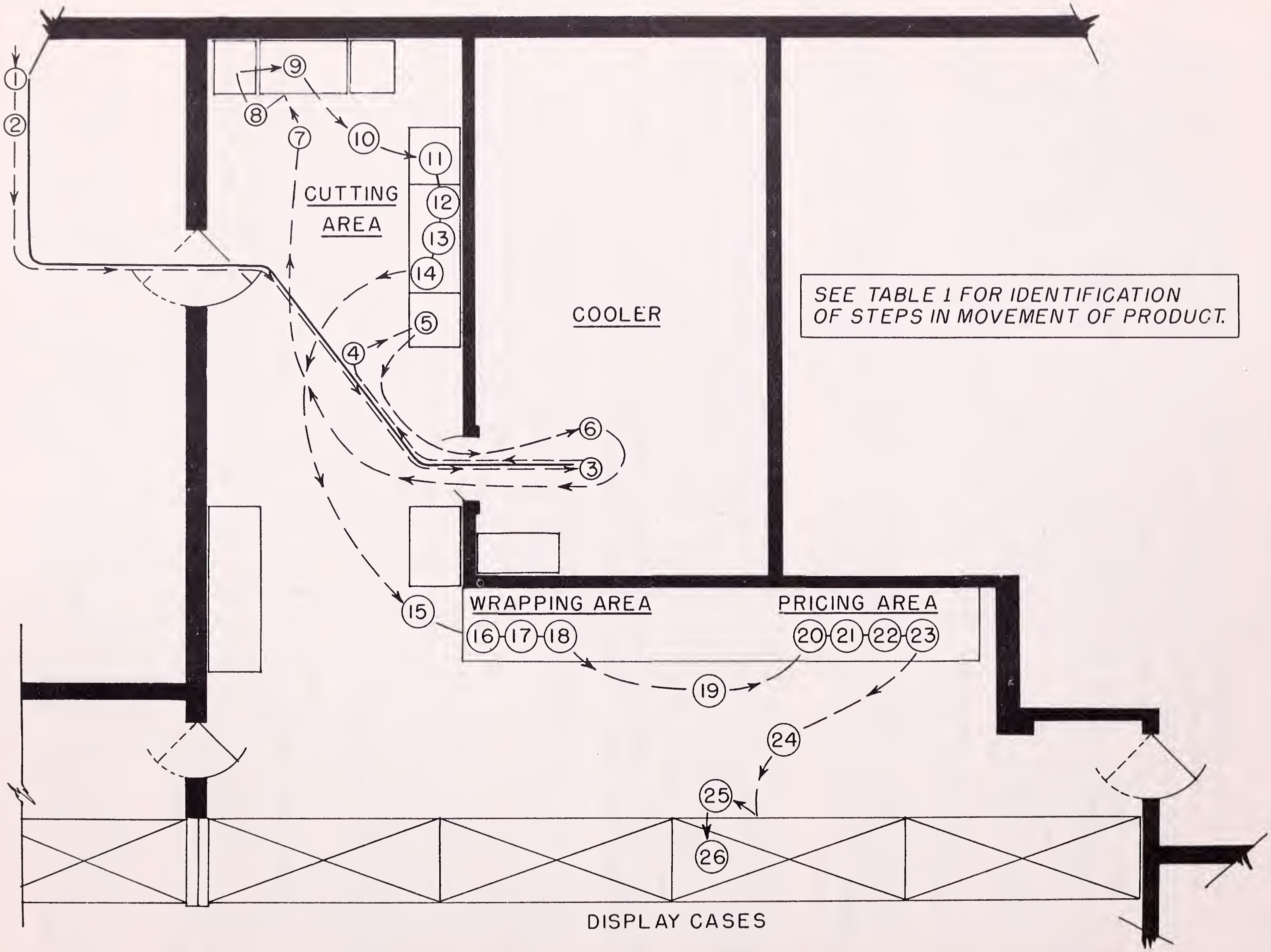
Alternative layouts can be most effectively compared when results are quantitatively measured. Such measurements should be based on the methods, materials, and equipment to be used in the layout and should cover the movement of all the primary products and the incidental movement of byproducts through the market. The study should be based on the handling methods used. Careful consideration of the flow of the following classes of products in a meat market should give a good evaluation of layout: (1) Red meat received on a rail, blocked and cut on a power saw; (2) byproducts, such as bones or fat, and trimmings used as stew beef or ground beef; (3) pork products, (4) poultry and fish; (5) luncheon meats and cheese packaged in the store; and (6) previously packaged items such as bacon, sausage, or luncheon meats requiring only pricing.

In addition, special consideration should be given to: (1) Handling of rewrap packages, (2) handling special orders for customers, (3) movement of workers from job to job, (4) disposal of trash and waste, and (5) movement and storage of supplies and materials.

Illustrative of the flow diagrams and step lists used in this study are those shown here for handling red meat cut on the power saw. An observer followed this product through the market operations and recorded each move and operation. This information was incorporated into a step list giving the distances moved and the weight of the product handled, Appendix table 1. A floor plan of the existing layout was made and the movement of the product was drawn on this floor plan (fig. 24).

The step list and the diagram were examined and each operation and handling movement of the product were analyzed. Consideration was given to the amount of effort exerted by workers in moving the product and in lifting excessively heavy loads. The following questions were raised and answered for every step in the operation and handling movement of the product: (1) Can it be eliminated? (2) Can it be simplified? (3) Can it be combined with another operation? (4) Would a change in sequence or location of an individual operation improve the overall operation? From answers to these questions and from similar data for other products, a new layout was developed. The flow of this product was then developed for the improved layout (fig. 25). The step lists and the flow diagrams for the different products for both layouts were then compared. In the improved layout red meat cut on a power saw moved 130 feet compared to 240 feet in the old layout (Appendix tables 1 and 2). In addition, human effort was further reduced by the use of mechanical means of moving the product. After several alternate layouts were examined the improved layout was selected and installed.

This type of analysis does not give a measure of the size of storage areas necessary or of the size of work places needed to do a job properly. These factors should be considered separately and before a measure of movement is made.



SEE TABLE 1 FOR IDENTIFICATION OF STEPS IN MOVEMENT OF PRODUCT.

Figure 24.--Product flow of beef cut on a power saw in a typical unimproved meat department layout.

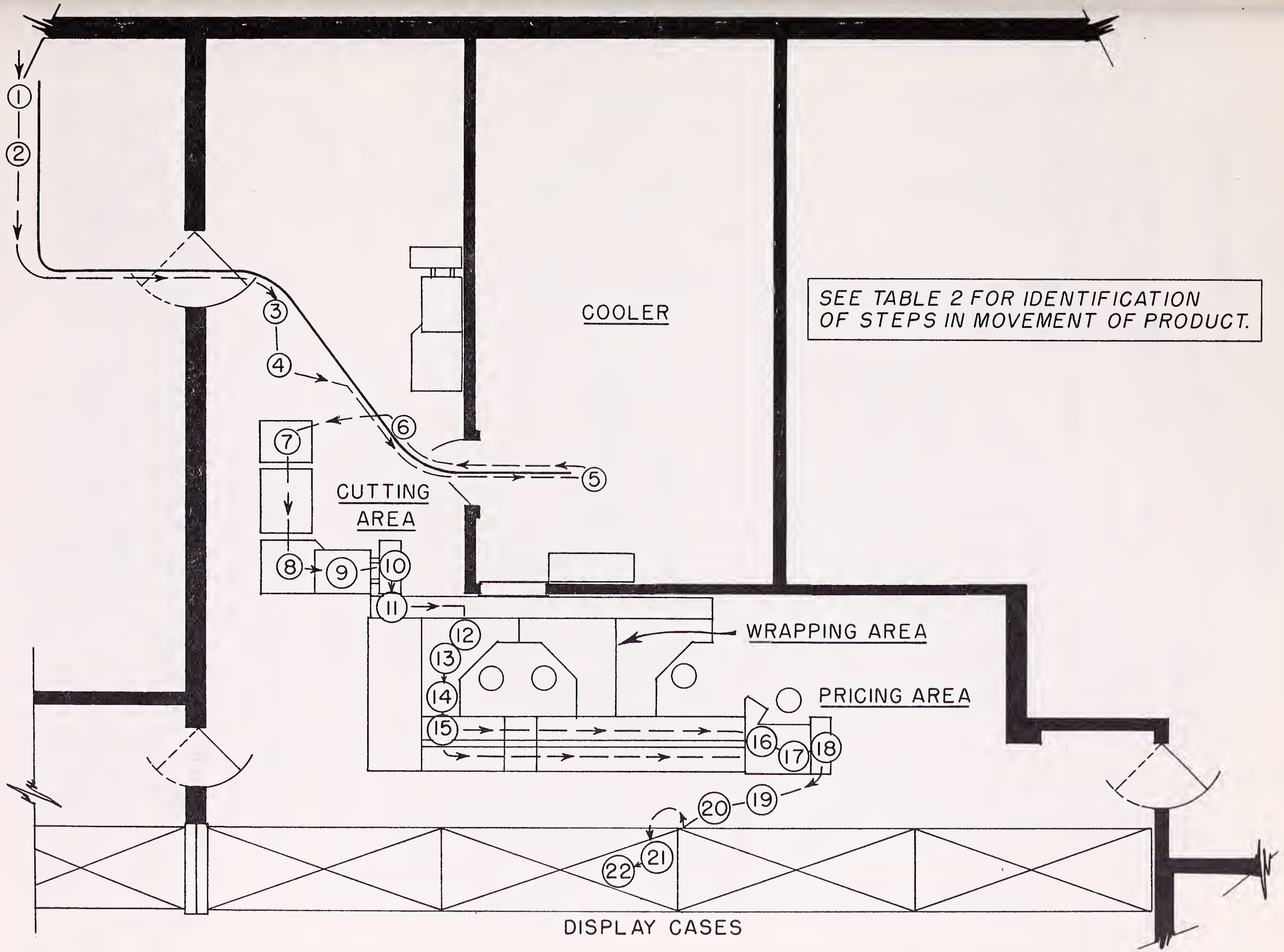


Figure 25.--Product flow of beef cut on a power saw after remodeling the typical layout shown in Fig. 24.

APPENDIX

Table 1.--Step list for moves in processing beef items cut on a power saw in an unimproved typical retail meat department

Step No. [1]	Steps in movement of product	Distance of lift or move	Average weight handled	Human effort required [2]
		Feet	Pounds	Pounds
1	Carry and lift quarter to rail (2 men)......	6	150	150
2	Move on rail to scale......................	6	150	[3] 22.5
3	Move on rail to cooler.....................	46	150	[3] 22.5
4	Move on rail to block......................	26	150	[3] 22.5
5	Move wholesale cut to block................	4	27	27
6	Move wholesale cut to cooler...............	28	54	54
7	Move wholesale cut from cooler to saw table.	38	54	54
8	Move wholesale cut from table to saw........	3	27	27
9	Move retail cut from saw to table..........	2	1.5	1.5
10	Carry retail cuts to cutting table.........	10	27	27
11	Obtain retail cut to trim..................	2	1.5	1.5
12	Lay retail cut on table....................	1	1.5	1.5
13	Obtain retail cut to wipe..................	1	1.5	1.5
14	Lay cut on pan after wiping................	2	1.5	1.5
15	Carry pan of product to wrapping area.......	20	22	22
16	Place pan in work area.....................	2	22	[4] 7.3
17	Move product from pan to table for wrapping.	2	1.5	1.5
18	Move product to pan after wrapping..........	2	1.8	1.8
19	Carry pan of product to scale..............	12	22	22
20	Place pan of product at scale..............	2	22	[4] 7.3
21	Place piece of product on scale............	2	1.8	1.8
22	Remove from scale and place on pan.........	2	1.8	1.8
23	Slide pan out of way.......................	2	22	[4] 7.3
24	Carry pan to case and place in holding cooler..................................	16	22	22
25	Remove pan from cooler and move to top of case....................................	3	22	22
26	Place packages in display..................	2	1.8	1.8
	Total number of feet traveled..........	240		

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[1] Numbers correspond to those shown in figure 24 where each movement of product is shown diagramatically and each move numbered.

[2] Actual weight or weight equivalent to lift or move the product.

[3] The amount of effort required to move a 150-pound side of beef on a meat rail was equivalent to lifting approximately 22.5 pounds.

[4] The amount of effort required to slide a pan of meat was approximately equal to lifting one-third the weight of the pan.

Table 2.--Step list for moves in processing beef items cut on a power saw after remodeling the typical layout

Step No. 1/	Steps in movement of product	Distance of lift or move	Average weight handled	Human effort required 2/
		Feet	Pounds	Pounds
1	Carry and lift quarter to rail (2 men)	6	150	150
2	Move on rail to scale	6	150	3/ 22.5
3	Move on rail to block	20	150	3/ 22.5
4	Place separate wholesale cuts on tree hooks in center of 8 quarters	6	27	27
5	Move cuts on rail to cooler	24	150	3/ 22.5
6	Push wholesale cuts on rail to power saw	22	150	3/ 22.5
7	Move wholesale cut from tree hook to saw table	4	27	27
8	Move retail cuts to holding area	2	1.5	1.5
9	Obtain retail cut to trim	2	1.5	1.5
10	Move retail cut to pan	2	1.5	1.5
11	Place pan on conveyor	2½	22	4/ 7.3
12	Move pan from conveyor to table	1	22	4/ 7.3
13	Obtain cut to wrap	2	1.5	1.5
14	Place wrapped piece on pan	2	1.8	1.8
15	Move pan to conveyor	2	22	4/ 7.3
16	Place package on scale	2	1.8	1.8
17	Remove from scale and place on pan	2	1.8	1.8
18	Move pan to dolly	3	22	22
19	Move dolly to display	11½	110	5/ 16.5
20	Remove pan from dolly and place in holding area	3	22	22
21	Obtain pan from holding area and move to top of case	3	22	22
22	Place packages in display	2	1.8	1.8
	Total number of feet traveled	130		

1/ Numbers correspond to those shown in figure 25 where each movement of product is shown diagramatically and each movement numbered.

2/ Actual weight or weight equivalent to lift or move the product.

3/ The amount of effort required to move a 150-pound side of beef on a meat rail was equivalent to lifting approximately 22.5 pounds.

4/ The amount of effort required to slide a pan of meat was approximately equal to lifting one-third the weight of the pan.

5/ The amount of effort required to move meat in a pan dolly rack was approximately equal to lifting 15 percent of the weight of the product.

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